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Mathematical Identities of Students with Mathematics Learning Dis/abilities

Emma Lynn Holdaway

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Arts

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ABSTRACT

Mathematical Identities of Students with Mathematics Learning Dis/abilities

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The majority of research on the mathematics teaching and learning of students with mathematics learning dis/abilities is not performed in the field of mathematics education, but in the field of special education. Due to this theoretical divide, students with mathematics learning dis/abilities are far more likely to be in classes that emphasize memorization, direct instruction, and the explicit teaching of rules and procedures. Additionally, students with mathematics learning dis/abilities are often seen as “unable” to succeed in school mathematics and are characterized by their academic difficulties and deficits.

The negative assumptions, beliefs, and expectations resulting from ableistic practices in the education system color the interactions educators, parents, and other students have with students with mathematics learning dis/abilities. These interactions in turn influence how students with mathematics learning dis/abilities view and position themselves as learners and doers of mathematics. My study builds on the theoretical framework of positioning theory (Harré, 2012) in order to better understand the mathematical identities of students with mathematics learning dis/abilities. The results of my study show how these students use their prepositions and enduring positions to inform the in-the-moment positions they take on in the mathematics classroom.

Keywords: identity, positioning theory, mathematics learning disability, dyscalculia

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CHAPTER 1: INTRODUCTION

Mathematics education researchers have long focused on mathematics education reform movements. These standards-based movements push for high-quality instruction that is founded on building students' conceptual understanding. The goal of these reform movements is to more successfully aid students in becoming mathematically proficient (Hiebert, 2003; National Research Council, 2001; Skemp, 1978/2006). While much research has been done on the effectiveness of these reform movements for students overall, mathematics education researchers have only begun to attend to issues of equity within the past few decades (Gutiérrez, 2013; Lubienski, 2002).

Equity research in mathematics education explores how factors such as gender, race, socioeconomic status, etc. affect students' mathematical learning. As these topics have gained momentum in mathematics education, gender-related research and research on the racial achievement gap have become very common. Though issues relating to gender and race are frequently discussed, equity research in mathematics education largely ignores other marginalized populations, such as students with dis/abilities¹ (Lambert & Tan, 2017).

The absence of students with dis/abilities within the field of mathematics education is highlighted by a position statement released by the National Council of Teachers of Mathematics (NCTM). This particular position statement underscores the importance of attending to equity within the mathematics classroom and calls for educators and researchers to support students “from all racial, ethnic, linguistic, gender, and socioeconomic groups” (NCTM, 2014, p. 1).

¹The term *dis/ability* comes from Tan & Kastberg (2017). They use this term to “forefront power imbalances inherent in constructing and identifying *dis/ability* and the consequences of such imbalances in and out of school. The concept of *dis/ability* as socially constructed offers an entryway to reconstructing what mathematics education researchers mean when they use the term ‘disability’ and to addressing inequities for individuals labeled with this educational and societal construct” (p. 1). By choosing to use the term *dis/ability*, I invite the reader to identify, critically reflect on, and actively counter the negative assumptions, connotations, and biases associated with the word “disability.”

Students with dis/abilities, however, are not mentioned in this charge to create and sustain equity for “all” students in the mathematics classroom. Students with dis/abilities have thus been called by Karp (2013) as *the invisible 10%* in mathematics education research.

In fact, most research on the mathematics teaching and learning for students with dis/abilities is not found in mathematics education journals, but in special education journals (Karp, 2013; Lambert, 2015; Lambert & Tan, 2016; Lambert & Tan, 2017; Tan & Kastberg, 2017). Lambert & Tan (2016) found that out of 408 peer-reviewed journal articles emphasizing mathematics teaching and learning, only 42 articles specifically included and attended to students with dis/abilities. Furthermore, only two of those 42 articles were found in mathematics education journals; the rest were published in special education or psychology journals.

The exclusion of students with dis/abilities—specifically students with mathematics learning dis/abilities—from mathematics education research is problematic. While current mathematics education reform movements underscore the importance of teaching mathematics conceptually and building students’ problem-solving abilities, special education pedagogical practices tend to emphasize memorization, direct instruction, and the explicit teaching of rules and procedures. Further analysis of the divide between mathematics education and special education has shown that research studies involving students without dis/abilities are much more likely to (1) be founded on constructivist or sociocultural learning theories and (2) cover a wide breadth of mathematical ideas and processes. Contrastingly, studies involving students with dis/abilities are much more likely to (1) be grounded in behaviorist and cognitive learning theories and (2) emphasize procedures rather than conceptual understanding, justification, or other important mathematical processes (Lambert & Tan, 2016; Lambert & Tan, 2017).

The differences between mathematics education and special education exist not only in theoretical and empirical research, but also in classroom practices. In a random survey of 129 secondary general mathematics and special education teachers, 95% of the general mathematics teachers reported they were familiar with the goals of standards-based mathematics reform movements. However, only 55% of the special education teachers reported they were familiar with the goals of standards-based mathematics reform movements (Maccini & Gagnon, 2002). This lack of awareness of mathematics education reform movements among special education teachers influences the pedagogy of special education classrooms. For example, one study showed that 75% of instructional time in pull-out special education classes for students with dis/abilities was focused on algorithmic instruction (i.e., emphasizing the memorization of facts and mathematical procedures) rather than conceptual instruction. Comparatively, only 30% of instructional time in general mathematics classes was focused on algorithmic instruction (Jackson & Neel, 2006). These instructional differences cause inequitable access to high-quality mathematics instruction for students with dis/abilities (Lambert & Tan, 2017).

The theoretical and pedagogical differences for students with and without dis/abilities are founded on assumptions that students with dis/abilities are unable to understand mathematics conceptually, engage in mathematical discourse, or successfully problem solve (Borgioli, 2008). The belief that students with dis/abilities are unable to meaningfully and effectively engage in these cognitive practices supports their exclusion from general mathematics classrooms and, as a result, mathematics education research (Borgioli, 2008; Lambert, 2015; Lambert & Tan, 2016; Lambert & Tan, 2017; Tan & Kastberg, 2017). Lambert & Tan (2017) commented on the effects of the exclusion of students with dis/abilities from mathematics education research:

The research divide constructs and reifies what many consider to be a “common sense” assumption: children with and without disabilities are different, and should be educated differently in mathematics. The pedagogical and methodological divides that separate research in mathematics on students with and without disabilities are a critical issue for mathematics education because they justify deficit constructions of students with disabilities, construct students with disabilities as passive rather than active learners of mathematics, and limit our understanding of how contexts shape learning for all students.

(p. 15)

These “common sense” deficit constructions of students with dis/abilities reinforce their exclusion from both conceptually-based mathematics classrooms and mathematics education research, reifying the ideology of ableism in mathematics education.

Ableism and Mathematical Identities

Ableism refers to the discrimination and prejudice against people with dis/abilities. Ableism is the practice of defining what it means to be “normal” and labeling people as either able or unable to fit that accepted and commonly-portrayed definition of normalcy (Borgioli, 2008). Just as with racism, sexism, and other isms, issues of power are at play with ableism. In school mathematics, ableism is perpetuated as “those in a position of (political, economic, and/or educational) power narrowly [define] what society and educators are to consider as acceptable ‘school mathematics’ as well as acceptable evidence for students’ demonstration of proficiency in school mathematics” (Borgioli, 2008, p. 133). For example, those in educational power have determined that the use of fingers to aid in simple arithmetic calculations is considered abnormal or unusual past a young age. In fact, some researchers have even cited that the use of fingers

“well beyond the age when it is *normal*” [emphasis added] is an observable indicator of mathematics learning dis/abilities (Butterworth, Varma, & Laurillard, 2011, p. 1049).

Students with mathematics learning dis/abilities are oppressed by current definitions of normalcy in school mathematics. Those in educational power have traditionally defined normalcy in school mathematics as the ability to perform mathematical computations and procedures quickly and accurately. Students with mathematics learning dis/abilities, however, often have difficulties with computational speed and accuracy (Butterworth, Varma, & Laurillard, 2011; Geary & Hoard, 2005; Lewis & Lynn, 2018; Mazzocco & Myers, 2003). Cognitive research has shown that these difficulties result from the fact that students with mathematics learning dis/abilities process numerical information differently than their non-dis/abled peers. Thus, accepting the traditional definition of normalcy and applying the lens of educational ableism labels students with mathematics learning dis/abilities as unable to demonstrate proficiency in school mathematics.

Current mathematics education reform movements, however, have pushed to redefine normalcy in school mathematics to include the ability to problem solve and understand mathematics conceptually (National Research Council, 2001; Skemp, 1978/2006). But even with this changing definition of normalcy, students with mathematics learning dis/abilities are still seen as unable to successfully participate and demonstrate proficiency in school mathematics (Anderson, 2009; Lambert, 2015). Thus, the practice of ableistic ideologies in mathematics education must be challenged, and we must stop labeling students with mathematics learning dis/abilities as “unable” to succeed.

Labeling students with mathematics learning dis/abilities as “unable” to succeed in school mathematics is extremely damaging. The label “unable”—and I also argue along with Tan

& Kastberg (2017) that the term “disability”—is inherently deficit-oriented. In line with these labels, mathematics learning dis/abilities are often characterized and defined by deficits, difficulties, and skill gaps. These deficit-oriented characterizations communicate that the barrier to mathematical success is located within the individual student rather than in broader systems and structures, effectively marginalizing and “othering” students with mathematics learning dis/abilities (El-Haj & Rubin, 2009; Lambert, Tan, Hunt, & Candela, 2018; Lewis, 2014). This marginalization leads to “inordinate segregation, low expectations, failure to provide accommodations, and misguided attempts to ‘cure’ disability” (Hehir, 2005, p. 42). These effects of marginalization as described by Hehir—along with labeling students as unable and defining dis/abilities based on perceived deficits—communicate negative assumptions, beliefs, and expectations regarding students with mathematics learning dis/abilities.

The negative assumptions, beliefs, and expectations resulting from ableistic practices in the education system color the interactions educators, parents, and other students have with students with mathematics learning dis/abilities. These interactions in turn influence how students with mathematics learning dis/abilities view and position themselves as learners and doers of mathematics. The roles that students with mathematics learning dis/abilities assume in regards to mathematics constitute their *mathematical identities*. Students’ mathematical identities are not formed completely independently; mathematical identities are also explicitly and implicitly influenced by experiences and interactions with others (Bishop, 2012; Davies & Harré, 2001; Harré, Moghaddam, Cairnie, Rothbart, & Sabat, 2009; Heyd-Metzuyanim, 2013).

Lewis & Lynn’s (2018) work underscores how students’ mathematical identities are influenced by experiences and interactions with others. Their research focused particularly on students with mathematics learning dis/abilities by describing the experiences of Dylan, a

statistics major at University of California, Berkeley. Dylan was diagnosed with dyscalculia (the clinical term for a mathematics learning dis/ability). When Dylan sought support for her dis/ability, the university informed her that the main accommodation they could provide was to waive the mathematics requirement. Lewis and Lynn commented on this “accommodation” with the following:

We view this as an exclusionary practice, which, rather than accommodating for disabilities, excludes those individuals from participation in mathematics. [...] Not only were the policies exclusionary, but [Dylan] was actively discouraged from pursuing and completing her degree in statistics. [...] Not only were the structures of assessment (time constraints) and the policies (weeder classes and disability waivers) sending messages to Dylan that she did not belong in upper division mathematics classes, but she often had graduate students devaluing her legitimate approaches to solving problems. (p. 13-14)

The interactions Dylan experienced with the university, professors, and graduate students communicated to her that because of her dis/ability, she was seen as incompetent and unable to succeed in mathematics courses. Though Dylan successfully completed her statistics degree, she had to consistently battle the negative and deficit messages she received about her ability to be a successful mathematician.

Not only do broader school structures and systems have the potential to negatively impact the mathematical identities of students with mathematics learning dis/abilities, but moment-to-moment social interactions that communicate deficit beliefs also cause significant harm. Bishop (2012) highlighted this through her analysis of the moment-to-moment interactions of two seventh-grade students, Teri and Bonnie. In an interview, Bonnie labeled herself as “the dumb one” and Teri as “the smart one.” Bishop classified several interactions between the two girls

that solidified Bonnie’s mathematical identity as “the dumb one.” Many of these interactions—such as the use of authoritarian voice, statements of inferiority, etc.—were used by Teri to subordinate Bonnie. For example, Teri used an authoritarian voice 53 times with Bonnie, whereas Bonnie only used an authoritarian voice once with Teri. Teri also used statements of inferiority to explicitly position Bonnie: “What is in that big head of yours? I mean, let me rephrase that, little head of yours? [...] You don’t have a penny in your freaking brain; you have nothing in there” (p. 54). These moment-to-moment interactions communicated Teri’s belief—whether conscious or subconscious—that Bonnie was not a capable mathematician. It is not hard to imagine that repeated exposure to these negative moment-to-moment interactions played into Bonnie’s self-label as “the dumb one.”

It is clear that the experiences and interactions students with mathematics learning dis/abilities have throughout their schooling influence the development and formation of their mathematical identities. However, as students with mathematics learning dis/abilities are a largely invisible population in mathematics education research, researchers and teachers are unaware of exactly how these experiences impact their mathematical identities, (i.e., the way they interact in class). As students with mathematics learning dis/abilities comprise approximately 7% of the school-age population (Geary, 2011), this unawareness can no longer continue.

According to critical research theories, it is crucial to attend to the experiences of non-dominant groups (Berry, Thunder, & McClain, 2011; Gutiérrez, Willey, & Khisty, 2011; Yosso, 2005). By listening to and validating the experiences of non-dominant groups, researchers can critique the deficit views that permeate discussions about these groups. Critical theories rely on the tenant of listening to the voices of underserved groups in order to learn how to better attend

to their specific needs. For example, Gutiérrez, Willey, & Khisty (2011) studied the experiences of urban Latinas/os in an after-school mathematics program. As researchers listened to their counterstories, the students themselves were able to describe the biases and oppression that they experienced every day from their own perspectives. Their stories then gave researchers insight into the changes that needed to be made in order to better serve urban Latinas/os.

It is time that mathematics education researchers attend to the voices of students with mathematics learning dis/abilities. They must be allowed to speak for themselves, describing the experiences they have had. By listening to the perspectives of these students, researchers will not only be able to better understand how their dis/abilities affect their interactions in their mathematics classes, but they will also be able to better attend to their specific and particular needs. Listening to the voices of students with mathematics learning dis/abilities the key to providing them with quality and equitable mathematics experiences.

CHAPTER 2: BACKGROUND

Literature Review

Mathematics education researchers must attend to the needs of students with mathematics learning dis/abilities in order to help these students develop positive mathematical identities. In order to better understand how to do this, I have reviewed literature in the fields of mathematics education, special education, and psychology. I first summarize research on students with mathematics learning dis/abilities. I then outline identity research, focusing specifically on how identity is conceptualized within the field of mathematics education.

Students with Mathematics Learning Dis/abilities

The majority of research on students with mathematics learning dis/abilities is found in special education journals (Karp, 2013; Lambert, 2015; Lambert & Tan, 2016; Lambert & Tan, 2017; Tan & Kastberg, 2017). As previously mentioned, the absence of research on students with mathematics learning dis/abilities in the field of mathematics education is problematic because of the theoretical and pedagogical differences between mathematics education and special education. While the field of mathematics education has undergone both cognitive and social revolutions—resulting in the frequent use of constructivist, sociocultural, and sociopolitical learning theories—the field of special education is still largely driven by behaviorist and information processing learning theories (Lambert & Tan, 2017). This divide between mathematics education and special education implies that students with mathematics learning dis/abilities and students without mathematics learning dis/abilities are two distinct kinds of learners (Lambert & Tan, 2016).

The perceived differences between students with and without mathematics learning dis/abilities are manifested through the research conducted in the fields of special education and

psychology. Special education and psychology literature widely define mathematics learning dis/abilities—sometimes abbreviated to MLD or clinically referred to as dyscalculia—from a deficit perspective. This deficit perspective implies that difficulties with mathematics result from problems or deficiencies within the individual student with the dis/ability. The following quotes from the literature highlight the repeated use of the word *deficit* to describe students with mathematics learning dis/abilities [emphasis added in each quote to illustrate]:

- “Recent research [...] is providing a new approach to the understanding of dyscalculia that emphasizes a *core deficit* in understanding sets and their numerosities” (Butterworth, Varma, & Laurillard, 2011, p. 1409).
- “A [mathematics] learning disability can result from *deficits* in the ability to represent or process information in one or all of the many mathematical domains” (Geary & Hoard, 2005, p. 253).
- “Children with MLD [...] have *deficits* in understanding and representing numerical magnitude, difficulties retrieving basic arithmetic facts from long-term memory, and delays in learning mathematical procedures” (Geary, 2011, p. 250).
- “The *deficit* concerns mastery of basic computational skills of addition, subtraction, multiplication and division” (World Health Organization, 2010, p. 194).
- “Mathematics difficulties might stem from or be associated with *deficits* or differences in various aspects of cognition, some general and some specific to mathematical knowledge” (Russell & Ginsburg, 1984, p. 218).

This brief selection of quotations emphasizes the acceptance of defining students with mathematics learning dis/abilities based on deficits or difficulties. In fact, defining mathematics learning dis/abilities based on deficits is more than just accepted: it is the norm. For example, in

Geary & Hoard (2005), students with mathematics learning dis/abilities—referred to in the chapter as “children with MD”—are referenced 51 times. In the same chapter, the word *deficit* is used 53 times. Sadly, these students’ “deficits” are mentioned more often than the students themselves.

In addition to these deficit-oriented descriptions, the literature on students with mathematics learning dis/abilities also over-emphasizes elementary aspects of mathematics. For example, many of the quotations above only reference basic arithmetic and computational skills. Research on students with mathematics learning dis/abilities is too narrowly focused on these basic skills (Lambert & Tan, 2017; Lewis, 2014). But mathematics is more than just being able to perform basic operations or retrieve number facts from memory. In fact, according to the *Common Core State Standards*, there are 11 mathematical domains: (1) Counting & Cardinality, (2) Operations & Algebraic Thinking, (3) Number & Operations in Base Ten, (4) Number & Operations—Fractions, (5) Measurement & Data, (6) Geometry, (7) Ratios & Proportional Relationships, (8) The Number System, (9) Expressions & Equations, (10) Functions, and (11) Statistics & Probability (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). How do students with mathematics learning dis/abilities make sense of and process information in more complex mathematical domains?

In their review of 40 years of research on mathematics learning dis/abilities, Lewis & Fisher (2016) call for research that addresses these deeper mathematical domains. Without this research, continuing to focus solely on elementary aspects of mathematics will perpetuate inequitable access to high-quality instruction for students with mathematics learning dis/abilities: “Pedagogy in mathematics for children with disabilities has focused on basic skills and direct

instruction, while pedagogy for children without disabilities has focused on conceptual understanding and problem-solving” (Lambert, 2015, p. 2).

Some mathematics education researchers have recognized these issues surrounding the research on students with mathematics learning dis/abilities and have begun to push against the narrow, deficit-oriented conceptualizations of these students (Lambert, 2015; Lambert, Tan, Hunt, & Candela, 2018; Lewis, 2014; Lewis & Fisher, 2016; Lewis & Lynn, 2018). For example, Lewis (2014) argues for a reconceptualization of mathematics learning dis/abilities, stating that dis/abilities should be viewed not as deficits, but as cognitive *differences*. These differences influence how students with mathematics learning dis/abilities process mathematical information. Lewis explored these differences in order to better understand how students with mathematics learning dis/abilities construct their mathematical understandings. Though Lewis’ work is important in moving away from ableistic tendencies to view dis/abilities as inherently deficient, her research emphasizes the cognitive processes students with mathematical learning dis/abilities use in order to make sense of mathematical information. She does not attend to how these differences influence the mathematical identities of students with mathematics learning dis/abilities.

Identity in Mathematics Education

In the past few decades, mathematics educators and researchers have begun to attend to the concept of identity (Anderson, 2009; Berry, Thunder, & McClain, 2011; Bishop, 2012; Boaler & Greeno, 2000; Cobb, Gresalfi, & Hodge, 2009; Esmonde & Langer-Osuna, 2013; Heyd-Metzuyanim, 2013; Johnson, 2016; Lambert, 2015; Martin, 2007; Wood, 2013; Yamakawa, Forman, & Ansell; 2009). Today identity work in mathematics education is becoming more and more common, and in 2016, the National Council of Teachers of

Mathematics specifically encouraged teachers to help students build positive mathematical identities (NCTM, 2016).

Instead of focusing solely on the cognitive factors related to learning and doing mathematics, identity work underscores the social and affective factors related to learning and doing mathematics. In general, identity research in mathematics education considers how students feel about mathematics, engage with mathematics, and the beliefs students have about their potential to be successful mathematicians (Cobb, Gresalfi, & Hodge, 2009; Wood, 2013). The study of identity has allowed mathematics education researchers to better understand how students connect with mathematics, including how factors such as race, language, and socioeconomic status affect this relationship (Berry, Thunder, & McClain, 2011; Esmonde & Langer-Osuna, 2013; Martin, 2007; Nasir & Shah, 2011).

Though researchers define identity in different ways, it is generally agreed that students' mathematical identities are socially constructed—meaning that the way students view themselves is shaped and influenced by how others view them (Barton, Kang, Tan, O'Neill, Bautista-Guerra, & Brecklin, 2013; Bishop, 2012; Heyd-Metzuyanim, 2013). Building on this idea of socially constructed identities, Heyd-Metzuyanim (2013) examined how mathematical identities—specifically dis/abled mathematical identities—are co-constructed through classroom interactions. She analyzed how the interactions between a teacher and Dana—a low-performing, seventh-grade student—led to Dana's repeated and perpetuated failure in school mathematics. Heyd-Metzuyanim—acting as both the researcher and the teacher—repeatedly described Dana's mathematical performance as “non-comprehensible,” “peculiar,” and “odd” (p. 349-352). These negative judgments of Dana's mathematical ability caused Heyd-Metzuyanim to “[give] up on trying to elicit a correct answer from her” (p. 350). From that moment on, she identified Dana as

incompetent. She did not call on Dana or ask for comments from her during class discussions. As a result, Dana was inhibited from opportunities to participate meaningfully in mathematical learning opportunities. Though Dana initially self-identified as a confident mathematician, the teacher's opposite view eventually affected her self-perception as a mathematician. This identity shift was illustrated in Dana's final interview where she said, "I'm not... good at it [at mathematics]" (p. 360).

In her work, Lambert (2015) also addressed the mathematical identities of students with dis/abilities. She explored how conceptualizations of dis/ability in the classroom influenced how students viewed themselves as mathematical learners. Over the course of two years, Lambert collected data in a middle school using participant observations and interviews. Her analysis specifically focused on students with learning dis/abilities. In class, the teacher separated the children into ability groups so that the children with IEPs could receive additional support from a special education teacher. The students quickly picked up on the differences between the groups. Luis—a student in the IEP group labeled as learning dis/abled—commented that “the groups were like smarter than others [although the] teachers don't say that. [...] [My group] is the unsmartest group” (p. 14). Though unstated, the differences in how the teacher interacted with each group did not go unnoticed by Luis and ultimately influenced how he identified as a mathematician.

Reflecting this social construction of identity, identity in mathematics education is typically studied using a sociocultural lens. The three most common sociocultural frameworks used by mathematics education researchers to conceptualize identity are (1) discourse theory (Gee, 1989), (2) figured worlds (Holland, 2001; Urrieta Jr., 2007), and (3) positioning theory (Harré, 2012).

Discourse theory is the first theoretical framework used to study identity. As described by Gee (1989), a Discourse is a way of speaking, acting, believing, and even being. A Discourse is thus an “identity kit” which when used correctly, allows someone to be recognized as a particular type or kind of person. Identity in Discourse theory is thus recognized as the different Discourses that a person is able to successfully engage in.

Moschkovich (2007) used Gee’s Discourse theory to analyze how a teacher and his third-grade students engaged in a mathematical discussion about trapezoids. In the discussion, the students concluded that a trapezoid represents half a parallelogram. The teacher, however, used subtle Discourse practices—such as continually rephrasing and re-asking the same question—to show that he did not agree with the students’ answer. Moschkovich concluded that the differences in the students’ and the teacher’s Discourse practices represented different kinds of mathematical engagement. She then outlined how different Discourses patterns can be used to identify categories of mathematical communities, such as “everyday, professional, academic, and school” (p. 26).

Figured worlds is another theory commonly used in mathematics education to conceptualize identity (e.g., Boaler & Greeno, 2000; Esmonde & Langer-Osuna, 2013). The theory of figured worlds is built on the idea that people interact and identify themselves in the context of *figured worlds*. Figured worlds are broad understandings, expectations, or narratives that give meaning to actions, artifacts, and activities (Holland, 2001; Urrieta Jr., 2007). Figured worlds are significant as they are the contexts within which people form their identities. Identity is defined as the self-understandings people create as they interact with those around them and take on specific roles in a figured world space.

Boaler and Greeno (2000) used the theoretical framework of figured worlds in order to understand the development of students' mathematical identities. They interviewed 48 students, asking each to describe his/her mathematics classroom environment. The students' descriptions of their learning environments gave the researchers insight to the figured world contexts that influenced the formation of the students' mathematical identities. Boaler and Greeno found that differences in the students' mathematical identities—as evidenced by different affinities towards mathematics and differing desires to continue studying mathematics—were correlated with differences in the students' mathematical figured worlds.

Lastly, mathematics education researchers frequently use positioning theory to study identity (Anderson, 2009; Herbel-Eisenmann, Wagner, Johnson, Suh, & Figueras, 2015; Johnson, 2016; Nasir & Shah, 2011; Wagner & Herbel-Eisenmann, 2009; Yamakawa, Forman, & Ansell, 2009). Positioning theory originates in the field of social psychology and defines identity as the positions people take on during a given social interaction. Positions are determined and negotiated through moment-to-moment interactions (Harré, 2012). A more in-depth discussion of positioning theory will be given in the following section.

Theoretical Framework

As previously described, there are multiple ways of conceptualizing identity within the field of mathematics education. I have chosen to situate my study within the framework of positioning theory. In this section, I describe the foundations of positioning theory, the aspects of positioning theory relevant to my analysis, and, ultimately, define identity/identities. I then state the specific research questions that guide this study.

Positioning Theory

Positioning theory—as named and developed by psychologist Rom Harré—describes and analyzes human interactions based on the *positions* that people assume in different social

situations. A position is a collection of *rights* and *duties*: rights refer to what other people must do for us, while *duties* refer to what we must do for other people. The rights and duties that constitute positions are assigned either explicitly or tacitly during in-the-moment social interactions (Harré, 2012).

Positioning theory has three main components: (1) positions, (2) communication acts, and (3) storylines (Harré, 2012). These three components are reflexive and represent the social and cognitive processes people use to guide their social interactions. The first component, positions, defines what a person can or cannot do in a given social interaction or situation. A person's position—determined by what she and others believe to be her rights and duties—can change depending on the situation and the people with whom she is interacting. Hence, positions are either confirmed or disputed by other social players during the assigning of rights and duties.

Bishop's (2012) analysis of the interactions between two 7th-grade mathematics students, Teri and Bonnie, highlights the distribution of the girls' rights and duties. In mathematics class, Teri is positioned as the "smart" student, while Bonnie is explicitly positioned as the "dumb" student. As evidenced through the girls' interactions, Teri assumes her right as the "smart" student and controls the pair's mathematical activity: she determines which problems they solve, what mathematical strategies they use, how long they spend on each problem, etc. Bonnie—positioned as the "dumb" student—has the duty to follow Teri's lead, especially since according to Teri, Bonnie has "nothing in that brain of [hers]" (Bishop, 2012, p. 54). The rights and duties that Teri and Bonnie take on during their interactions shape their resulting positions.

The second component of positioning theory, communication acts, refers to the social interactions people use to position themselves and others. These interactions—including speech, gestures, and even physical location—determine how rights and duties are distributed among

individuals. Bishop (2012) categorizes the different communication acts that Teri uses to position herself and Bonnie, including using an authoritarian voice, making statements of inferiority, and using face-saving moves to avoid the appearance of failure. Every communication act has a specific social meaning, which may or may not be correctly interpreted by all participants. In other words, the intention behind a behavior may not always match how the behavior is socially interpreted by others.

The third component of positioning theory, storylines, refers to how we expect a given situation or interaction to occur. A storyline is thus a generally accepted understanding (either explicit or implicit) of some aspect of life (Harré, 2012). Explicit storylines exist when the rules governing a situation are clearly stated, such as in ceremonies and rule-bound games. Social players know exactly what to expect and what positions they should assume. Implicit storylines rely on the idea that “strips of life are usually lived stories for which told stories already exist” (Harré, 2012, p. 198). Social players rely on these told stories in order to frame and interpret positions and communication acts. However, just as with positions, storylines can be negotiated or constructed throughout the course of an interaction (Johnson, 2016).

Prepositioning

Before any given interaction or social situation takes place, all social players engage in what is known as *prepositioning*. Prepositioning is the process of identifying and evaluating personal characteristics—either of oneself or of someone else—that will be pertinent to a given interaction or situation (Harré, Moghaddam, Cairnie, Rothbart, & Sabat, 2009). As one cannot position oneself without positioning others, social players preposition both themselves and those with whom they will be interacting. Prepositioning is essentially a preliminary claim of the rights and duties people believe they and others have (or do not have) before interacting or

participating in a situation. The situational assessment of prepositioning influences one's view of the overarching storyline, which then frames one's interpretation of the other components of positioning theory: positions and communication acts. As a result, prepositioning affects our ability to successfully fulfill the rights and duties of whatever position we are assigned to once the interaction or situation begins.

Enduring Positions

According to traditional positioning theory, positions are short-term (Harré, 2012). As a result, traditional positioning theory focuses on in-the-moment social interactions, claiming that positions are dependent on localized contexts. Thus, a person's position in one situation has no impact on her position in another situation. However, some mathematics education researchers have suggested that positions are not only influenced by in-the-moment interactions, but also by broader and more permanent categorizations of people (Anderson, 2009; Johnson, 2016). These broader, more permanent categorizations arise as people repeatedly interpret in-the-moment interactions as contributing to a more general way or sense of being. This repeated interpretation of interactions results in consistently taking on or being assigned the same position. Repeated association with the same position leads to stable identities, which Johnson (2016) refers to as *enduring positions*.

Enduring positions—whether developed intentionally or unintentionally—heavily influence the way others interpret or attend to one's social interactions. Anderson's (2009) analysis of the small-group interactions between four fifth-grade students demonstrates how enduring positions can shape social interactions. The study focused on the students' use of a conversation rubric that guided their mathematical discussions, with the goal of sharing and understanding one another's reasoning. Anderson (2009) focused on a particular student, Nate,

and his position in the group. During the group's first discussion, Nate's mathematical reasoning and contributions were consistently ignored by his group members. Instead of trying to understand his reasoning as the rubric directed, the other students repeatedly laughed and said they did not get what he was saying. They positioned Nate as incompetent and solidified that position by refusing to acknowledge his contributions or even make eye contact with him. Nate was unable to shift his position in the group and eight weeks later was still viewed as incompetent. Even when Nate demonstrated clear mathematical understanding, these in-the-moment interactions did not change his group's perception of the *kind* of student that he was. Because of his enduring position as mathematically inferior, his contributions to the group were "delegitimized" and "devalued" (Anderson, 2009, p. 301).

Identity

For my study, I define identity in terms of the rights and duties that students assume during social interactions. In line with positioning theory, identities are thus synonymous with positions and are manifested and negotiated through the communication acts of social interactions. As discussed, these communication acts can be both explicit and implicit, including verbal dialogue as well as gestures, body language, and even physical positioning within a space.

Defining identity as a position implies that identity is fluid, under constant negotiation, and uniquely constructed during in-the-moment social interactions. Some researchers have expanded traditional positioning theory, however, claiming that identities are not solely dependent on in-the-moment social interactions. These researchers claim that factors such as prepositions and enduring positions also influence identities (Anderson, 2009; Harré et al., 2009; Johnson, 2016).

My study builds on this theoretical framework of positioning theory and attends to three factors that influence the mathematical identities of students with mathematics learning dis/abilities: (1) in-the-moment communication acts, (2) prepositions, and (3) enduring positions. Students' mathematical identities are specifically the positions they negotiate during any social interaction that is related to mathematics, such as participation in the mathematics classroom. However, both prepositions and enduring positions influence the moment-to-moment positions that students take on in the mathematics classroom.

Research Questions

After reviewing the literature on students with mathematics learning dis/abilities and mathematical identities, I have determined that more research needs to be done on how students with mathematics learning dis/abilities identify as learners and doers of mathematics. Using the theoretical framework of positioning theory as described above, the research questions guiding this study are:

1. What prepositions and enduring positions do students with mathematics learning dis/abilities describe in their experiences with mathematics learning?
2. What positions are observed by a researcher in the current mathematics classes for the same students with mathematics learning dis/abilities?
3. How do these positions compare with one another?

CHAPTER 3: METHODS

Participants

I first identified two focal students with a mathematics learning dis/ability. Though there is debate in the educational community about how to properly diagnose a mathematics learning dis/ability (Borgioli, 2008), any student who was receiving educational support specifically for mathematics qualified for participation in my study. After receiving approval from two school districts in the Mountain West United States, I recruited participants by distributing informational flyers to all approved middle and high schools. I specifically used secondary schools because middle and high school students have greater metacognitive abilities, allowing them to better reflect on and analyze their mathematical experiences. Additionally, I reasoned that middle school and high school students would have most likely formed stable conceptualizations or storylines of what it meant to meaningfully and successfully participate in a mathematics classroom.

After distributing the flyers to the schools, I followed up with individual mathematics and special education teachers via email. I encouraged the teachers to tell their eligible students about the study and invite them to contact me for more information if they were interested. Through these methods, I was able to recruit two eligible students.

Focal Student #1: Jasmine

Jasmine² was a White female who was 15 years old at the time of data collection. When we first met, Jasmine's mother gave me a complete background of Jasmine's educational history, stating that she first noticed that Jasmine was struggling academically in kindergarten. Jasmine's early elementary school teachers told her mother not to worry and that with time, she would

²All names are pseudonyms.

eventually catch up. However, Jasmine still continued to struggle throughout her upper-elementary school years, and in fourth grade, she was tested and qualified to receive special education services.

Jasmine's mother gave me copies of Jasmine's report cards and diagnostic tests, including her most recent diagnostic test from a mathematics learning center. The test placed Jasmine at a sixth-grade level in mathematics. Her report card also showed that Jasmine had failed her most recent mathematics test.

Jasmine was a middle school student in ninth-grade, and I observed her during her first period Secondary Math I class. Jasmine's school was on a block schedule, so she had class every other day for 90 minutes. There were 26 students in the class, five boys and 21 girls. The students sat in seats assigned by Mrs. Pratt, the teacher, but the desks were arranged in groups of four to encourage group work and collaboration. Mrs. Pratt used a variety of pedagogical approaches—including whole-class instruction, group work, and stations—in her teaching. Jasmine's class started each day by reviewing their homework; the students would grade their own work while Mrs. Pratt read the answers off from an answer key. Following the homework review, the students would complete a short warm-up before starting the day's activities.

Focal Student #2: Taylor

Taylor was of Asian descent and was 15 years old at the time of data collection. She moved to the United States when she was adopted at five years old, so English was her second language. Taylor had been receiving special education support since elementary school. At the time of data collection, Taylor was receiving IEP accommodations in many of her classes, including specific accommodations for her mathematics learning dis/ability. Before I met Taylor

in person, she felt the need to clarify her gender identity by sending me the following email:
“Just a heads up I may look like a boy but I’m a girl.”

Taylor was a ninth-grade student at a junior high school, and I observed her during her first period Secondary Math I class. She had this class every morning for 60-70 minutes, depending on the day of the week. There were 30 students in the class. The desks were arranged in columns facing the board at the front of the room. Mrs. Jones—Taylor’s teacher—employed direct instruction in her teaching. Every day, Mrs. Jones explained concepts and filled in answers to worksheets which she projected on the board using the document camera. Students would follow along in their notebooks and copy down the answers Mrs. Jones wrote down. After this direct instruction, Mrs. Jones would sometimes encourage the students to try a few problems on their own. There was little to no group work or collaboration amongst the students. There was also a special education co-teacher in the classroom who would occasionally assist Mrs. Jones in helping students while they were working individually.

Data Collection

To collect data, I used both interview protocols and classroom observations which allowed me to attend to the prepositions, communication acts, and enduring positions that influenced my focal students’ mathematical identities.

Pre-Interviews

I conducted initial interviews with my two focal students in order to reveal the prepositions and enduring positions they used to inform their in-the-moment positions in their mathematics classrooms. As previously discussed, prepositions are students’ judgments about the rights and duties they believe they and others should have. These judgments are made before any interaction occurs. Enduring positions—or consistent categorizations of people—result from

repeatedly taking on or being assigned the same position. Both prepositions and enduring positions influence in-the-moment positioning.

In order to reveal my focal students' prepositions and enduring positions, I asked questions such as "How do you feel math has been going for you this year? ," "Are you more likely to participate during class or listen? Why? ," and "How do you feel about being labeled as mathematics learning dis/abled?" Answers to questions such as these highlighted the initial judgments students had about themselves and others as participants in the mathematics classroom as well as the particular *kinds* of mathematics students they proclaimed to be.

I have included a copy of my complete pre-interview protocol in Appendix A.

Classroom Observations

After completing the pre-interview with each focal student, I performed a period of classroom observations. The classroom observations gave me insight to the moment-to-moment interactions between my focal students, their peers, and teachers. As described in my theoretical framework, individuals interact using communication acts such as speech, gestures, and even physical location to position themselves and others. These communication acts helped reveal the positions that constituted my students' mathematical identities. As I observed my focal students, I kept record of the specific communication acts related to how they participated mathematically, how they interacted with their teacher, and how they interacted with other students.

I observed each focal student as they participated in their general mathematics classes with their non-dis/abled peers for five complete class periods. This time period was long enough for me to make reasonable conclusions about my focal students' in-the-moment positions. To record my data on these in-the-moment positions, I used a three-column observational protocol. In the first column, I recorded descriptions of the communication acts in the overall classroom.

In the second column, I recorded the interactions specifically regarding my focal student. In the last column, I recorded my initial thoughts, reactions, and analysis.

In my observational protocol, I also kept track of the total number of interactions that occurred throughout the class. I defined an interaction to be an initiation for communication, whether made by the teacher or a student. Generally, an initiation for interaction was followed by a response from another participant. However, there were times when a teacher or student would initiate interaction without receiving a desired response. These exchanges—though seemingly one-sided—were still counted as interactions. I classified each classroom interaction in my notes using the following codes:

- Teacher-student non-mathematical (TSN): Any interaction between the teacher and a student that did not involve mathematical content, such as giving general directions, classroom management, praise, non-school related topics, etc.
- Teacher-student mathematical (TSM): Any interaction between the teacher and a student that involved mathematical content
- Teacher-focal student non-mathematical (TFN): Any interaction between the teacher and the focal student that did not involve mathematical content, such as giving general directions, classroom management, praise, non-school related topics, etc.
- Teacher-focal student mathematical (TFM): Any interaction between the teacher and the focal student that involved mathematical content
- Student-student non-mathematical (SSN): Any interaction between two or more students that did not involve mathematical content
- Student-student mathematical (SSM): Any interaction between two or more students that involved mathematical content

- Student-focal student non-mathematical (SFN): Any interaction between a student and the focal student that did not involve mathematical content
- Student-focal student mathematical (SFM): Any interaction between a student and the focal student that involved mathematical content

Post-Interviews

After completing five classroom observations, I did a final interview with each of my focal students. I used my post-interviews to explore any interactions from the observations that I identified as particularly meaningful with respect to my focal students' mathematical identities. I identified an interaction as particularly meaningful if the student or myself had a visceral reaction to what happened in the interaction. This reaction was sometimes evident in non-verbal cues such as sighing, gasping, or perceived changes in engagement with the class. Depending on the time between the observations and the post-interviews, I used my field notes to briefly remind students of the context of the interaction if necessary. I then asked them to explain why they interacted the way they did, how the interaction did or did not represent them as mathematics student, how they felt during the moment of interaction, etc. I have included my complete post-interview protocol in Appendix B.

As a researcher, I was biased in processing and interpreting the interactions I observed, and I assigned meaning to them based on these personal interpretations. I was aware that it was possible that the interactions I designated as relevant or salient did not match the interactions that my focal students labeled as relevant or salient. In order to address this possible mismatch, I also asked the students to reflect on any other interactions they found particularly meaningful and to explain why the interactions I identified were less impactful to them.

I also used the post-interviews to further explore any themes that emerged during my initial data analysis and as an opportunity to member-check, verifying with my focal students that my initial findings and results resonated with them and accurately reflected their feelings and experiences.

Data Analysis

Pre- and Post-Interviews

In the pre- and post-interviews, I examined the prepositions and enduring positions that my focal students described in their mathematics experiences. They used these prepositions and enduring positions to guide their interactions in their mathematics classrooms. In order to examine the data for evidence of these prepositions and enduring positions, I first transcribed each interview and then used a multi-phase discourse analysis (Gee, 2011).

For the first phase of my analysis, I identified any rights and duties that the student described. In accordance with positioning theory, *rights* referred to what others needed to do for the student and *duties* referred to what the student needed to do for others (Harré, 2012). As rights and duties are the building blocks of positions, identifying these components was the first step to revealing the prepositions and enduring positions that my students with mathematics learning dis/abilities used to describe their mathematical experiences. I then separated the transcript into blocks of correlated rights and duties.

For phase two of my analysis, I examined each block of correlated rights and duties to decide whether they represented a preposition or an enduring position. Prepositions and enduring positions were distinct. First, prepositions were preliminary claims of rights and duties that occurred before an interaction took place (Harré, Moghaddam, Cairnie, Rothbart, & Sabat, 2009). Prepositions were also identified by descriptions of how an interaction that the student

had not experienced *might* occur. I identified prepositions whenever the student made judgements about how she and others should or should not interact in the mathematics classroom. Second, enduring positions were positions that the student repeatedly or consistently took on and identified with (Johnson, 2016). Enduring positions represented the students' descriptions of their actual experiences in the classroom, rather than their expectations of how their experiences *should* have been. I identified enduring positions by more overt statements such as, "I am bad at math" or "I always get the wrong answer no matter what."

For the final phase of my analysis, I labeled each preposition or enduring position with a descriptive phrase that best summarized or represented its overall meaning and/or implications for the student's mathematical identity.

The three phases of my interview analysis are summarized in Table 1.

Table 1

Phases of Analysis for Pre- and Post-Interviews

Phase of Analysis	Questions guiding this phase
Phase 1	What implied rights and duties are expressed? (e.g., "I should be able to...", "I have the right to...")
Phase 2	Do these rights and duties represent a preposition or an enduring position?
Phase 3	What descriptive phrase best summarizes or describes this preposition or enduring position?

In order to give a more concrete example of this multi-phase process, I will now describe and briefly analyze an interview excerpt from one of my focal students. In Jasmine's pre-interview, she mentioned she liked to participate in class because it helped her learn better. I followed up on that statement, asking Jasmine why participating was beneficial for her. She said, "Well, like for instance, like, if I've already done the equations then I could like write it on the

board or whatever. And then like other people can say if it's wrong or right, and I learn from that.”

In this interview excerpt, Jasmine communicated that she had the right to participate in class by sharing her work on the board. Her statement also indicated that other students in the class had the duty to validate Jasmine’s mathematical work as either correct or incorrect. This group of rights and duties represented a preposition because at the time of the pre-interview, Jasmine had never shared her mathematical work on the board. Since she had never personally experienced this interaction, she was instead describing her expectations of how this interaction should occur. I labeled this preposition as *participating in class*.

Observations

As with my interview data, I also used a multi-phase discourse analysis to study my observational data. I examined my observational data for the communication acts that my focal students used as they participated in the mathematics classroom. These communication acts revealed reveal my focal students’ in-the-moment positions (i.e., their mathematical identities).

For phase one of my analysis, I surveyed my field notes to identify the communication acts or interactions that took place with my focal student. I then separated my notes into blocks that corresponded with those specific interactions. As I defined previously, an interaction began with an initiation for communication. The length of the interactions varied. Some interactions were a brief exchange between participants (such as the teacher asking a question and the student answering), while some interactions included multiple turns between participants (such as a longer conversation). A new interaction was defined whenever the subject of the conversation changed or the participant(s) initiated interaction with a new person. Additionally, some

interactions were defined by an initiation for communication with no response from the intended participant (such as the student raising her hand and not being called on by the teacher).

For phase two of my analysis, I evaluated each interaction block for the rights and duties it portrayed. Rights and duties—negotiated through the communication acts of an interaction—were the building blocks of my focal students’ in-the-moment positions. As a result, identifying the rights and duties in each interaction revealed the position(s) that the student took on.

Finally, for phase three, I described each position with a descriptive phrase that best reflected the context of the interaction.

The three phases of my observational analysis are summarized in Table 2.

Table 2

Phases of Analysis for Classroom Observations

Phase of Analysis	Questions guiding this phase
Phase 1	What interactions occurred with the focal student?
Phase 2	What rights and duties (i.e., positions) are portrayed in the interaction?
Phase 3	What descriptive phrase best summarizes or describes the position(s) reflected in this interaction?

In addition to the analysis described above, I also counted the different kinds of interactions that occurred throughout the observational period (e.g., teacher-student non-mathematical, student-focal student mathematical, etc.). I described all of these categories in the “Classroom Observations” subsection earlier in this chapter. After totaling the numbers for these different categories, I calculated the percentage of interactions that my focal student participated in. I present these percentages in Chapter 4.

CHAPTER 4: RESULTS & DISCUSSION

In this chapter, I describe and discuss the results of my data analysis. For each focal student, I present the results to each of my three research questions. To remind the reader, the research questions that guided my study were:

1. What prepositions and enduring positions do students with mathematics learning dis/abilities describe in their experiences with mathematics learning?
2. What positions are observed by a researcher in the current mathematics classes for the same students with mathematics learning dis/abilities?
3. How do these positions compare with one another?

After outlining the results to my three research questions, I then discuss the implications of these results.

Results

Focal Student #1: Jasmine

Research Question #1: Prepositions and Enduring Positions

Prepositions. Jasmine used prepositions to describe her experiences with mathematics learning. She specifically used prepositions to describe (1) her expectations of how interactions *should* occur in the mathematics classroom and (2) interactions she had not yet experienced as a mathematics student.

Below I list each preposition Jasmine described and outline the corresponding rights and/or duties for that preposition. I also provide an example of each preposition from the data.

One preposition Jasmine frequently mentioned was *receiving help from the teacher*. This preposition represented the expectation Jasmine had to receive help and feel supported by her mathematics teacher. She expounded on this right by expressing the need for a teacher who was

patient and encouraging. This preposition also represented the right Jasmine had to ask her teacher questions if she did not understand the material. The preposition of receiving help from the teacher was evident in her pre-interview when Jasmine said, “Um, what makes a good teacher? Them encouraging you and helping a lot when you need it.”

Another preposition Jasmine described was *receiving help from other students*. This preposition represented the right Jasmine believed she had to receive help from her peers. Jasmine spoke about how students should encourage each other in both mathematical and emotional ways. In her pre-interview, she stated that students can help each other be successful by “Um, maybe like helping them. And encouraging them by like saying good stuff. Like making them happy.”

Jasmine also described the preposition of *participating in class* to highlight the right she had to share her mathematical work in order to learn. Jasmine said, “Well, like for instance, like, if I've already done the equations then I could like write it on the board or whatever. And then like other people can say if it's wrong or right, and I learn from that.” This statement represented a preposition because, at the time of this interview, Jasmine had not shared any of her mathematical work with the entire class on the board.

Jasmine used the preposition *overwhelmed* to describe how she would react if she were to fail in fulfilling her duties as a mathematics student. This preposition thus represented the right Jasmine had to have an emotional reaction to participating in class. For example, when asked how she would feel if she shared an answer with the class and her answer was wrong, Jasmine responded, “Overwhelmed. I don't know. I would just feel overwhelmed.”

The last preposition Jasmine described was *ostracized*. This preposition represented the expectation Jasmine had that the students in her current mathematics class would judge her

because of her mathematics learning dis/ability. Hence this preposition represented the right other students had to position Jasmine as different or incompetent. Jasmine's expectations for this preposition were based on a previous experience she had in elementary school when her friends stopped talking to her once they found out she had a learning dis/ability. When asked if Jasmine thought the same thing would happen in her current mathematics class, she responded, "I still feel like they [her current classmates] would judge me or something."

Enduring Positions. Jasmine also used enduring positions to describe her experiences as a mathematics student. The enduring positions she described were representative of her consistent and repeated experiences in the mathematics classroom. The enduring positions also represented the *kind* of mathematics student she believed herself to be. It is important to note that though an enduring position may have the same name as one of the prepositions described above, Jasmine's descriptions of her repeated experiences (i.e., the enduring positions) did not always match her expectations of how these interactions *should* occur (i.e., the prepositions).

Below I list each enduring position Jasmine described by outlining her corresponding rights and/or duties. I also provide an example of each enduring position from the data.

One of the most common enduring positions Jasmine mentioned was *receiving help from the teacher*. This enduring position represented Jasmine's right to be supported by her teacher and receive individualized help and attention. It was evident from Jasmine's interviews that this enduring position was especially important for her. When asked how her mathematics class was going for her that year, Jasmine immediately responded with, "Mrs. Pratt actually like really helps me with everything." Throughout her interviews, Jasmine continued to provide evidence for this enduring position by praising Mrs. Pratt: "Like the teacher I have makes me feel better."

Another enduring position Jasmine talked about was *receiving help from other students*. This enduring position represented the right Jasmine had to be helped by her classmates. In her pre-interview, Jasmine mentioned that her friend Melissa “helps me with math.”

Jasmine used the enduring position of *participating in class* to describe both the right and the duty she had as a student to participate in class. In describing herself as a mathematics student, Jasmine said, “I like to participate. I feel like I learn better.” This excerpt from Jasmine’s pre-interview represented the right she had to participate in order to further her own mathematical learning. In Jasmine’s post-interview, I followed up about her in-class participation. She said, “I’ve gotten a little bit better.” This excerpt demonstrated the duty Jasmine had to participate in class, a duty that she indicated she had gotten better at with time.

Understanding mathematics was another enduring position Jasmine talked about. It represented both the right and the duty Jasmine had to comprehend mathematical content. In her pre-interview, Jasmine expressed this right to understand mathematics by describing her teacher who was patient with her: “She moves slow. I don’t like it when teachers go like really fast.” Jasmine preferred teachers to move slowly so she could better process the mathematical information. This enduring position also represented the duty Jasmine had as a student to understand the material. In her pre-interview, Jasmine said she felt that her learning dis/ability made her worse at mathematics because she sometimes failed to understand: “Cause, like, sometimes, like, I don't know what to do.” The duty to understand mathematics was also evident when Jasmine described a remediation breakout session her teacher had her attend during class: “It was kind of embarrassing, kind of not. But I'm actually glad she [her teacher] did 'cause I understood it better than I did the last time.” This excerpt highlighted the purpose of the

remediation session, which was to aid Jasmine in fulfilling her duty of understanding the material.

Jasmine also described the enduring position of *overwhelmed*. This enduring position demonstrated the right Jasmine had to have an emotional reaction to how her learning dis/ability impacted her life. Jasmine took on the position of overwhelmed in response to many different factors, including tests in her mathematics class and judgments from friends and family. For example, Jasmine said, “[Tests] make me feel overwhelmed and nervous.” Additionally, when asked how she felt when her family members made fun of her and called her retarded, Jasmine responded, “Very bad. Well like... overwhelming.”

Jasmine was understandably emotional when she described the enduring position of *ostracized*. This enduring position represented the right others assumed to exclude, ridicule, or judge Jasmine because of her learning dis/ability. Jasmine was positioned as ostracized by many people in her life, including her family members and friends. When she was first diagnosed with a mathematics learning dis/ability in fourth grade and began receiving special education services, Jasmine’s extended family members said things like, “Jasmine, you’re in these classes. You’re retarded. You’re on the retarded bus.” In addition to the ridicule from her family members, Jasmine’s friends also positioned her as ostracized. In her pre-interview Jasmine said, “[Being labeled as learning dis/abled] would hurt. Because in fourth grade like I found out the hard way how I didn’t have any friends. I had a few friends, and then they stopped being my friend.”

The last enduring position Jasmine mentioned was the *need for social acceptance*. This enduring position represented the right Jasmine had to be accepted by her peers, regardless of her mathematics learning dis/ability. This enduring position affected how Jasmine interacted mathematically with her classmates. When asked if it was important for her to feel comfortable

with her group members before receiving mathematical help from them, Jasmine said, “It depends on how like I feel or whatever. So like sometimes I feel like it's okay, like, cause they're new people. And sometimes I'm kind of like... I don't know you!”

Research Question #2: Observed Positions

To answer my second research question, I list and describe the in-the-moment positions Jasmine took on over the course of five class periods. I describe each position by outlining Jasmine’s corresponding rights and/or duties and give an example of each position from the data. I then present the frequencies for the total number of interactions over the course of five class periods.

An important position Jasmine took on was the *lack of mathematical participation*. This position represented Jasmine’s right to decline to participate in mathematical activity. However, this position could also be interpreted as Jasmine’s failure to fulfill her duty of participating in class. For example, at one point during my observations, all of Jasmine’s other group members were discussing the differences between linear and exponential functions: Jasmine was the only one who did not participate in this discussion. Furthermore, throughout the entire observational period, Jasmine never answered her teacher’s questions when she came to check on Jasmine’s group. Comparatively, all of Jasmine’s group members at some point had a mathematical interaction with the teacher.

Though Jasmine more frequently displayed a lack of mathematical participation, there were times during the observational period that she took on the position of *participating in class*. This position represented her duty to share her mathematical ideas. Jasmine took on this position when she was confident in her understanding of the material. During one class period, the girls at Jasmine’s table were sorting different functions in order to determine if they were linear,

exponential, or neither. Jasmine said, “Wait... $4x$ would be multiplication. Maybe that one would go here [indicated the exponential pile].” Jasmine’s explanation convinced her group members that this particular function was exponential. In this instance, Jasmine’s idea was taken up by her group members. There was also a time when Mrs. Pratt—Jasmine’s teacher—called her up to the board to share her work on the warm-up. She had Jasmine draw and label an acute angle as well as describe how she knew the angle she drew was acute.

The position *non-mathematical teacher interaction* illustrated the right Jasmine had to interact with her teacher non-mathematically. For example, Jasmine once asked her teacher if she could go to the bathroom. At times this position also represented the duty Jasmine had to follow her teacher’s instructions, such as when her teacher came over to show Jasmine where to fill in the notes on her paper.

Another position Jasmine displayed was *helping other students*. This position represented both the right Jasmine had to receive help from others as well as the duty she had to help other students. In one instance, Jasmine expressed her right to receive help by handing her paper to a girl at her table, saying, “I’m not sure about this one.” Her group member was then able to help Jasmine understand that particular question. During another class period, Jasmine displayed her duty to help others by asking the girl next to her: “Do you want me to get you a calculator?”

The position of *mathematical inferiority* represented many rights and duties. First, it represented Jasmine’s duty as learning dis/abled to defer to the mathematical authority of other students. In one of my observations, Jasmine started explaining her answer to a question. However, she was cut off as one of her group members began to talk over her and take over the explanation. The position of mathematical inferiority also represented the right others had to ignore Jasmine’s mathematical contributions. For example, Jasmine said the following to her

group: “So it should be... so... so it should be seven, right?” No one was listening to Jasmine, however, because her group members were watching another student complete a problem.

Throughout the observational period, Jasmine took on the position of *need for social acceptance*. This position demonstrated the right Jasmine had to participate in casual conversations with other students as well as the right she had to be socially accepted by them. It was very common for Jasmine to interact with her group members non-mathematically, so this was the most frequent position Jasmine assumed during the five observational periods. For example, this position was evident when a girl at Jasmine’s table asked, “Did you guys watch the Super Bowl on Sunday?” Jasmine responded, “Yeah, I did.”

Another position I observed Jasmine take on was *ostracized*. This position represented the right others had to ignore or ostracize Jasmine. As a result, this position was given to Jasmine involuntarily on her part. For example, one of the girls at Jasmine’s table went to get a calculator for supposedly everyone in the group. But when she came back, she had only gotten a calculator for herself and for the girl next to her. As a result, Jasmine and one other girl at the table were left without calculators.

The final position I observed Jasmine take on was *overwhelmed*. This position represented the right Jasmine had to have a negative emotional reaction to mathematics. For example, after Mrs. Pratt announced that there was going to be a quiz, Jasmine sighed and put her head in her hands.

In addition to observing the positions Jasmine took on during the five class periods, I also counted and categorized the number of interactions between the teacher and a student for the entire class. Since Jasmine’s class included a significant amount of small group work, I also

counted the number of interactions between the students in Jasmine's group. I present the numbers for each category of interactions in Tables 3 and 4.

Table 3

Teacher-Student Interactions

	Teacher-Student Mathematical Interactions	Teacher-Student Non-mathematical Interactions
All Students	158	132
Jasmine	2	7
Jasmine's Percentage of Interactions	1.27%	5.30%

Table 4

Student-Student Interactions

	Student-Student Mathematical Interactions	Student-Student Non-mathematical Interactions
All Students	71	67
Jasmine	28	42
Jasmine's Percentage of Interactions	39.44%	62.69%

Research Question #3: Comparing Stated and Observed Positions

To answer my third research question, I compare the prepositions and enduring positions Jasmine described with the positions I saw her take on or assigned to her during the observational period. There are important similarities and differences between Jasmine's descriptions and my observations. I discuss the implications of these similarities and differences further in the discussion section later in this chapter.

The following were the positions that both Jasmine described in her interviews and I noticed in my observations: (1) *receiving help from/helping other students*, (2) *participating in class*, (3) *need for social acceptance*, (4) *overwhelming*, and (5) *ostracized*.

The following were the positions that Jasmine described in her interviews that I did not see in my observations: (1) *receiving help from the teacher* and (2) *understanding mathematics*.

The following were the positions that I observed but that Jasmine did not describe in her interviews: (1) *lack of mathematical participation*, (2) *mathematical inferiority*, and (3) *non-mathematical teacher interaction*.

Figures 1 and 2 below display the frequencies of each preposition, enduring position, and position from the coded data. These frequencies provide the reader with a useful comparison between Jasmine's descriptions and my observations. Note that the positions that appeared in both the interviews and the observations have the same color in both figures. The percentage on each slice represents how often that particular preposition, enduring position, or position appeared in the coded data. Comparing the percentages of a particular position in either figure begins to highlight some of the similarities and differences between Jasmine's descriptions and my observations. For example, though *receiving help from the teacher* appeared 16 times—or in 23.9% of the coded interview data—that position did not appear at all in the observations.

These charts do not tell the complete story behind the similarities and differences between Jasmine's descriptions and my observations. As previously mentioned, I will further analyze these similarities and differences in the discussion section of this chapter.

Figure 1

Jasmine's Prepositions and Enduring Positions

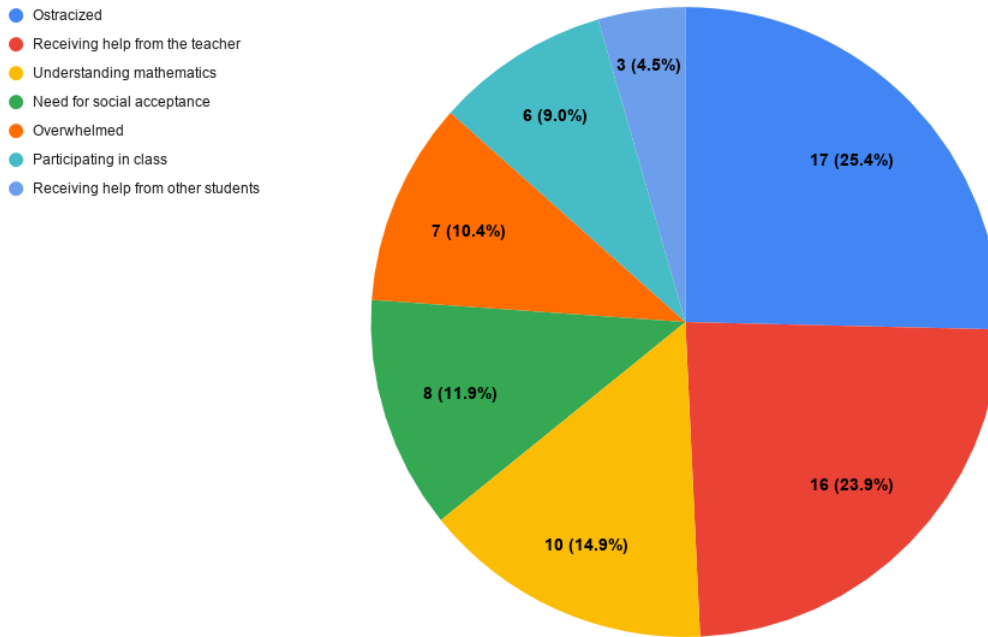
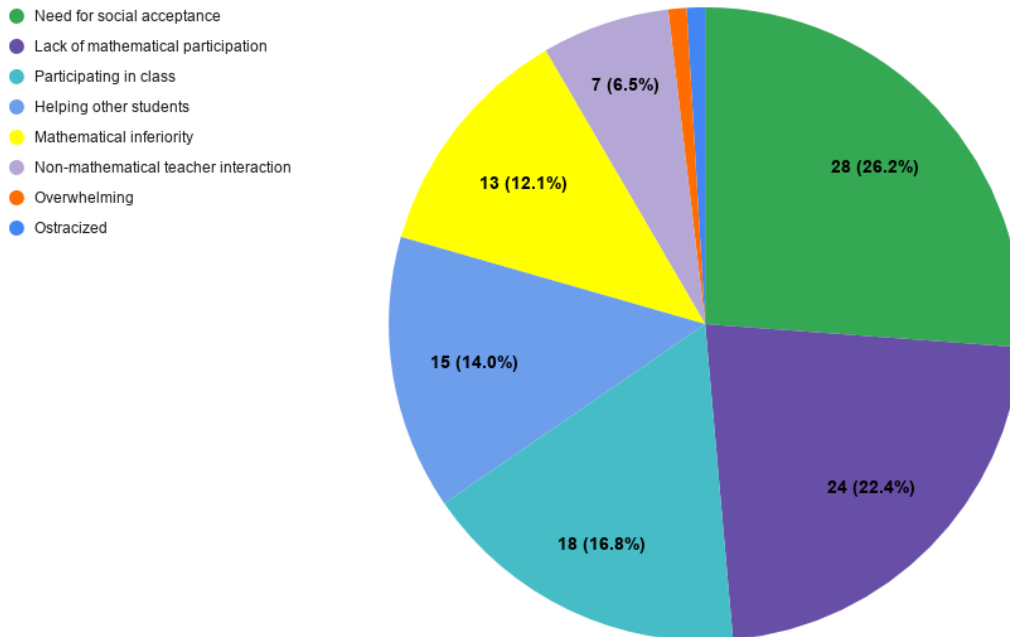


Figure 2

Jasmine's Positions



Focal Student #2: Taylor

Research Question #1: Prepositions and Enduring Positions

Prepositions. Taylor used prepositions to describe her experiences with mathematics learning. She specifically used prepositions to describe (1) her expectations of how interactions *should* occur in the mathematics classroom and (2) interactions she had not yet experienced as a mathematics student.

Below I list each preposition Taylor described and outline the corresponding rights and/or duties for that preposition. I also provide an example of each preposition from the data.

The first preposition Taylor described was *not smart*. This preposition represented the expectation Taylor had that she would fail to fulfill her duty to understand mathematics. Taylor believed her failure to fulfill this duty was a result of her mathematics learning dis/ability. When asked in her pre-interview how she would feel if she shared an incorrect answer during class, she said, “Quite embarrassed. It just probably would make me not feel smart or anything. ’Cause to have a learning disability... it's harder.”

Taylor also talked about the preposition *invisible*. This position represented the right Taylor believed she had to rely on the mathematical knowledge of other students by withholding her own participation. In her pre-interview, she described how she would participate in a small group setting: “Like if you're in a group, and they have to do... they have an activity to do with the lesson... I just like to see other people do it ’cause it makes more sense.” This excerpt highlighted Taylor’s preference to remain invisible during small group work by not participating.

Taylor described another preposition of *working alone*. This preposition represented the expectation Taylor had to work alone instead of in a group with other students. When I asked her which of her classmates she preferred to work with during class, Taylor said, “To me, I work

alone. I don't have anybody that I prefer. But if I'm looking for someone, they would be probably on task. Like the ones who don't goof around and they like just stay on task.” So though Taylor preferred to work alone, she mentioned that if she had to work with another student, she would want them to be focused and on task.

Another preposition Taylor outlined was *receiving help from the teacher*. This preposition represented the right Taylor had to receive help from a teacher, specifically one who was patient with her. When describing the characteristics of an effective mathematics teacher, Taylor said, “I would say really patient, but also works with, um... people who doesn't [sic] get things very well.” This quote represented the right Taylor believed she had as a student who struggled to receive individualized help from her teacher. She further outlined this preposition by describing the contrasting characteristics of an ineffective mathematics teacher: “Um, they would rush and they would kind of get mad or something like that if you keep re-asking the question.”

Taylor lastly described the preposition of *asking questions* to represent the right she believed she had to ask her teacher questions. Taylor believed that asking a lot of questions would help her as a student to better understand the material. She expressed this during her pre-interview when asked what a student should do to be successful in mathematics class: “Ask a lot of questions even though you may think you ask a lot of questions, just like me. They help you. Really.”

Enduring Positions. Taylor also used enduring positions to describe her experiences as a mathematics student. The enduring positions she described were representative of her consistent and repeated experiences in the mathematics classroom. The enduring positions also represented the kind of mathematics student she believed herself to be. It is important to note that though an enduring position may have the same name as one of the prepositions described above, it does

not imply that her repeated experiences (i.e., the enduring positions) always matched her expectations of how these interactions *should* occur (i.e., the prepositions).

Below I list each enduring position Taylor described by outlining the corresponding rights and/or duties. I also provide an example of each enduring position from the data.

One of the enduring positions Taylor described was *different than others*. This enduring position represented the right Taylor had to have an emotional reaction to her circumstances, which included having a mathematics learning dis/ability and being adopted. In her pre-interview, Taylor described her feelings about being labeled as learning dis/abled: “I feel like I'm different and I'm not as smart as people.” In addition to feeling different academically, Taylor also described that she felt different because she was of Asian descent and came to the United States when she was adopted at five-years-old:

Well, the thing is... I'm adopted, and I have an IEP. And other people are like born here or somewhere else. And they're pretty much raised as a baby, instead of like you were here at this age or something. I am physically different, but also I came here differently. But also in a different language.

Taylor believed these differences influenced the way people treated her. She also expressed her belief that others were not aware that they treated her differently. For example, she said that her teachers were “kind of easy” on her. She also said that her friends spoke to her differently, though she believed they did so unintentionally:

Well, like they kind of talk like a soft voice... like when people talk to babies or something like that. So they kind of talk a little like saying... I don't know... they talk soft, and they don't talk normally.

In her post-interview, Taylor succinctly summarized her feelings about the enduring position of different than others: “To me, I think different is bad.”

Another enduring position that Taylor described was *unsure*. This enduring position represented the right Taylor had to be uncertain of how her mathematics learning dis/ability affected her. There were times during the pre- and post-interview that Taylor did not know how to describe or articulate her feelings. For example, when I asked her how her learning dis/ability affected her participation in class, she said, “I don’t know.” In addition to these few instances, Taylor also demonstrated the enduring position of unsure by asking questions about her learning dis/ability. For example, in the post-interview, she asked the following: (1) “What does it mean to have a learning disability? ,” (2) “Is a learning disability divided into different groups? Or is it kind of all similar in different subjects? ,” and (3) “What can I do to get help with my learning disability?” These questions demonstrated Taylor’s lack of knowledge about her learning dis/ability, including what it meant and how it affected her learning. She told me she did not attend her IEP meetings with her parents and teachers, which could account for some of her uncertainty.

Taylor also frequently described the enduring position of *not smart*. This enduring position represented Taylor’s failure to fulfill her duty to understand mathematics. In her pre-interview, Taylor mentioned she had previously been in a “slow class” for mathematics. She described this class by saying, “I don’t know what they call it, but pretty much a small class where people don’t know really how to do math. And their schedule is to take it slow.” Because she had previously been in this class, Taylor self-identified as not smart or slow at mathematics. Though she was in a higher-level class at the time of the study, Taylor still described the enduring position of not smart/slow: “This class just goes a little faster. But also sometimes my

teacher just talks way too fast for me and my brain to process everything.” Taylor also expressed that she was a “terrible” student because she was slow at mathematics, explaining that at times she refrained from asking questions because it slowed her down even more. In addition to believing that she was not smart because she was slow, Taylor also mentioned that her label as learning dis/abled made her not smart at mathematics.

Though Taylor frequently expressed her belief that she was not smart, there were also times she described the enduring position of *successful at mathematics*. This enduring position represented the instances Taylor fulfilled her duty to understand mathematics. For example, when asked in her pre-interview how her mathematics class had been going for her that year, she responded, “Um... for now it's going pretty okay.” Though it is clear from Taylor’s hesitation and choice of words that she was not completely confident in her mathematical abilities, this enduring position was distinct from the instances she described herself as not smart.

Invisible was another enduring position Taylor described. This enduring position represented the right Taylor had to remain invisible and unnoticed by her classmates. Taylor made an effort to never draw attention to herself in class, thus helping her remain invisible. She stated that she preferred to just listen in class rather than participate, explaining that she did not like to ask or answer questions in front of other students: “It's just that everybody's listening and paying attention to me. And I just don't like being pressured.”

Another enduring position Taylor described was *working alone*. This enduring position represented the right Taylor had to work alone instead of in a group with other students. Taylor described her preference to work alone: “Well, people are not bothering me. I feel like it's easier to focus more ‘cause to me, I work better... kind of better alone.” In her post-interview, Taylor also mentioned that she did not have any friends in her mathematics class. Though there were a

few students that she would sometimes socialize with before class, she said, “I mostly consider them as classmates” rather than as friends.

Taylor also described the enduring position of *receiving help from the teacher*. This enduring position represented the right Taylor had to have a teacher who explained mathematical concepts clearly. She highlighted this enduring position by describing one of her previous mathematics teachers: “But pretty much last year I had a math teacher and she explained it very well.”

The last enduring position Taylor mentioned was *asking questions*. This enduring position represented the right Taylor had to ask questions in order to help her understand mathematical concepts. In her post-interview, Taylor mentioned that she was having trouble understanding geometric shapes, which was the topic her teacher was covering in class at the time. When I asked her to tell me more about that, she said, “I have been kind of asking for help.” Because Taylor did not like to ask questions in front of her classmates, she would instead wait to ask when her teacher walked around to help individual students. She also mentioned that she would go see her teacher before school for additional help if needed.

Research Question #2: Observed Positions

To present the results of my second research question, I list and describe the in-the-moment positions Taylor took on over the course of five class periods. Since Taylor’s classroom was very teacher-centered and included little to no group work, the majority of the positions I observed portrayed Taylor’s relationship with her teacher. I describe each position by outlining Taylor’s corresponding rights and/or duties. I also give an example of each position from the data. I then present the frequencies for the total number of interactions for the five class periods.

The most common position Taylor took on when interacting with her teacher was *non-mathematical teacher interaction*. This position represented the right Taylor had to have a warm, friendly relationship with her teacher. Taylor had her mathematics class first period and often spent her free time before the bell socializing with her teacher and a few other students. I observed a few exchanges between Taylor and Mrs. Jones, her teacher, during this time before class that highlighted their good relationship. For example, once Taylor held up a piece of paper Mrs. Jones gave her and said laughing, “Jones! I don’t want this!” The position of non-mathematical teacher interaction also represented the duty Taylor had to follow her teacher’s instructions. For example, there were times Mrs. Jones would instruct Taylor where to fill in her notes or where to turn her papers in.

Another common position Taylor was given was the *lack of mathematical feedback*. This position represented the teacher’s failure to fulfill her duty to provide Taylor with individualized mathematical feedback. During class, it was common for Mrs. Jones to walk around and help students as they individually worked on problems. However, it was rare for Mrs. Jones to give Taylor specific mathematical help. For example, during one observation, she only quickly glanced at Taylor’s work as she passed by, saying nothing. During a different class period, the teacher looked at Taylor’s work and only commented, “Very good.” This brief, non-mathematical comment was one of the few times Taylor received any feedback on her work.

As it was rare for the teacher to check Taylor’s work, there were only two times in the five observational periods that Taylor received individualized mathematical instruction. I labeled this position as *direct instruction*. This position represented that Taylor did not have the right to share her mathematical ideas, but instead had the duty to follow the mathematical procedures given to her by her teacher. During one observation, Taylor’s teacher came up to her and said,

“Do you know what’s going on here? Take the square root of that.” She did not wait for Taylor to answer her first question before giving her explicit instructions on how to proceed with the problem. In fact, Taylor did not participate at all during this interaction.

Though the class was very lecture-based, the teacher would still ask students questions, call on individual students for answers, and would occasionally ask for whole-class participation. During these instances, however, Taylor assumed the position of *invisible*. This position represented both Taylor’s right to remain invisible as well as her failure to fulfill her duty to participate in class. For example, Taylor never raised her hand to ask or answer a question during class. Additionally, one time the teacher asked the entire class a question, instructing them to indicate their answer with a “Thumbs up if you agree, thumbs down if you disagree.” In this instance, Taylor took on the position of invisible and did not participate by putting her thumb up or down.

Another position I observed Taylor take on was *working alone*. This position represented the right Taylor had to work alone instead of with other students in the class. After the teacher reviewed the material for the day, the students would complete practice problems in their notebooks. Some students in the class worked together or talked during this time, but Taylor always chose to work silently by herself.

The last position I observed Taylor take on was *pre-/post-class social interaction*. This position represented the right Taylor had to socially interact with her peers before or after class. Before class started, Taylor would spend her time in the classroom with her teacher and a few other students. Taylor would greet these students and would participate in casual conversations with them. For example, one day before class, the girls were discussing how Taylor had given

one of their classmates the nickname of “Broccoli.” Though the girls appeared to have a friendly, comfortable relationship before class, Taylor did not interact with them once class began.

In addition to observing the positions Taylor took on during the five class periods, I also counted and categorized the number of interactions between the teacher and a student for the entire class. As Taylor’s class did not participate in small group work, I did not count the number of interactions between students. Though I did not attend to student interactions for the general class, I still counted the interactions Taylor had with other students. I present the numbers for each category of interactions in the Tables 5 and 6.

Table 5

Teacher-Student Interactions

	Teacher-Student Mathematical Interactions	Teacher-Student Non-mathematical Interactions
All Students	168	109
Taylor	2	7
Taylor’s Percentage of Interactions	1.19%	6.42%

Table 6

Student-Student Interactions

	Student-Student Mathematical Interactions	Student-Student Non-mathematical Interactions
Taylor	0	4

Research Question #3: Comparing Stated and Observed Positions

To answer my third research question, I compare the prepositions and enduring positions Taylor described with the positions that I saw her take on or be assigned to her during the observational period. There are important similarities and differences between Taylor's descriptions and my observations. I discuss the implications of these similarities and differences further in the discussion section.

The following were the positions that both Taylor described in her interviews and I noticed in my observations: (1) *invisible* and (2) *working alone*.

The following were the positions that Taylor described in her interviews that I did not see in my observations: (1) *different than others*, (2) *unsure*, (3) *not smart/slow*, (4) *successful at mathematics*, (5) *receiving help from the teacher*, and (6) *asking questions*.

The following were the positions that I observed but Taylor did not describe in her interviews: (1) *non-mathematical teacher interaction*, (2) *lack of mathematical feedback*, (3) *direct instruction*, and (4) *pre-/post-class social interaction*.

Figures 3 and 4 display the frequencies of each preposition, enduring position, and position from the coded data. Note that the positions that appeared in both the interviews and the observations have the same color in both figures. The percentage on each slice represents how often that particular preposition, enduring position, or position appeared in the coded data. Comparing the percentages of a particular position in either figure begins to highlight some of the similarities and differences between Taylor's descriptions and my observations. As previously mentioned, I will further analyze these similarities and differences in the next section of this chapter.

Figure 3

Taylor's Prepositions and Enduring Positions

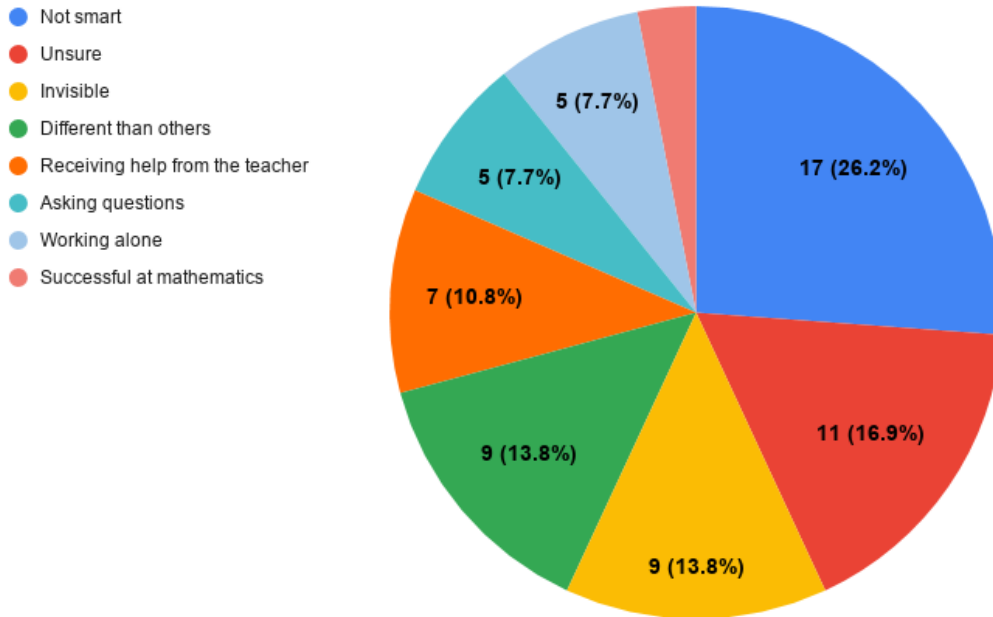
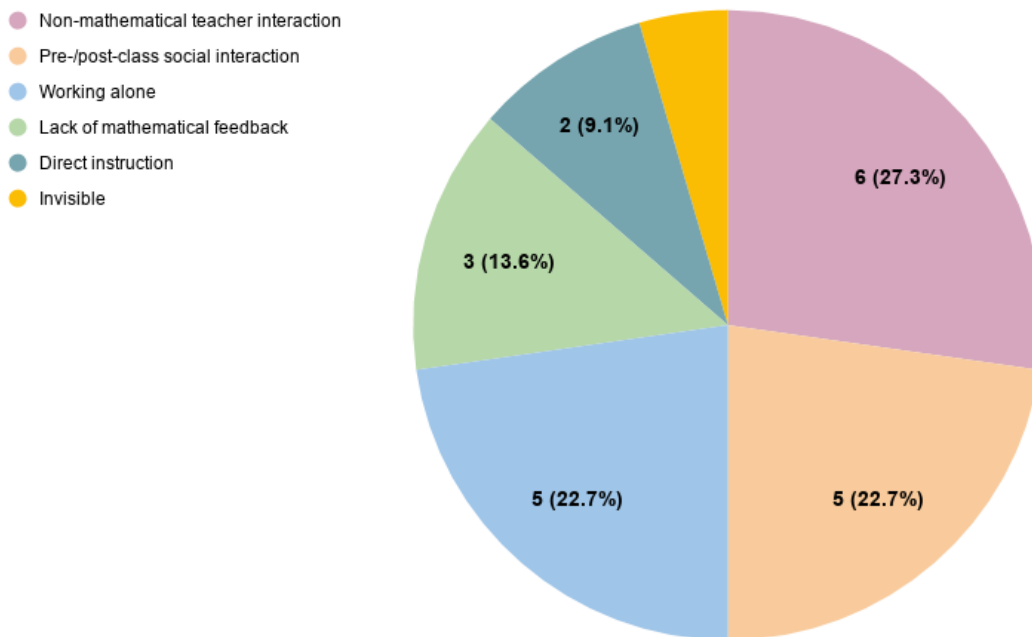


Figure 4

Taylor's Positions



Discussion

The purpose of my study was to better understand how students with mathematics learning dis/abilities form their mathematical identities. I remind the reader that I defined a student's mathematical identity to be the interactional positions which they adopted in-the-moment. These positions were informed by the student's preconceived notions of what would happen during those interactions (i.e., prepositions) and their repeated previous experiences (i.e., enduring positions). So, in order to more deeply understand the mathematical identities of students with mathematics learning dis/abilities, I attended to their (1) prepositions, (2) enduring positions, and (3) in-the-moment positions. In this section, I analyze the results of my study by discussing how these three components relate together to form each student's mathematical identity. I first discuss each student individually and then compare and contrast the two focal students.

Focal Student #1: Jasmine

Social Relationships

Based on Jasmine's prepositions, enduring positions, and in-the-moment positions, there were two main groups of people that shaped her mathematical identity: (1) her teacher and (2) her peers. These social relationships were very influential for Jasmine's identity, more so than any academic difference she had as a result of her learning dis/ability. For example, when asked how class was going for her that year, instead of describing her mathematical strengths or weaknesses, Jasmine instead described how her teacher supported and helped her. Additionally, when asked how her learning dis/ability affected her mathematical abilities, she once again mentioned how her teacher made her feel better at mathematics. Though it was clear from Jasmine's interviews that her teacher profoundly shaped her relationship with mathematics, there

was a disconnect between the interactions I actually observed Jasmine have with her teacher, Mrs. Pratt. For example, Jasmine only had two mathematical interactions with Mrs. Pratt compared to the 158 total mathematical interactions between the teacher and an individual student for the class overall.

This disconnect between Jasmine’s descriptions and the interactions I observed was not because Jasmine painted an inaccurate picture of her teacher. I observed Mrs. Pratt attempt to interact with Jasmine in class by frequently coming to visit her group and by once asking Jasmine to share her mathematical work. Despite Mrs. Pratt’s attempts, Jasmine was the one who limited the in-class interactions with her teacher. For example, when Mrs. Pratt would come check in on Jasmine’s group, Jasmine never asked or answered any questions. She instead would look down at her paper, avoid eye contact, and bite her nails. In her post-interview, Jasmine clarified that she behaved this way because she would get nervous or overwhelmed in class.

This nervousness came from a fear of what would happen if her classmates found out that she had a mathematics learning dis/ability. Based on her previous experiences, Jasmine was worried that if her peers knew about her learning dis/ability, they would judge her and stop being her friend. This fear not only fueled Jasmine’s position of *need for social acceptance*, but also influenced Jasmine’s interactions with her teacher. Instead of interacting with her during class where it was possible that she would make a mistake in front of her peers, she would go see her before or after school if she needed help.

Jasmine’s need for social acceptance from her peers not only influenced her interactions with her teacher, but also influenced how she viewed her mathematics learning dis/ability. For example, when I asked Jasmine in her pre-interview how her learning dis/ability affected her participation in class, she responded, “Well, like in past years, yeah... like it hurt me really bad

because I didn't have any friends.” Once again, Jasmine did not describe how her academic or cognitive differences impacted her participation, but instead described the social implications of her learning dis/ability, or the enduring position of *ostracized*. Jasmine wanted so badly to be accepted by her peers, but her learning dis/ability had hindered that in the past. Thus, her need for social acceptance affected her positioning more than any difficulty she might have had with the mathematical content.

The in-the-moment positions I observed Jasmine take on were consistent with her described preposition and enduring position of *need for social acceptance*. For example, she took mathematical precautions in her interactions with her peers, often deferring to the mathematical authority of others. She was also hesitant to participate mathematically with her peers unless she was comfortable socially with them. In order to achieve and maintain this social comfort, she would frequently engage in casual conversations with her group members.

The fact that Jasmine’s in-the-moment positions were heavily influenced by her those around her—specifically her teacher and her peers—supports the identity work done in the field of mathematics education (Barton, Kang, Tan, O’Neill, Bautista-Guerra, & Brecklin, 2013; Bishop, 2012; Heyd-Metzuyanim, 2013; Lambert, 2015). For example, in Bishop’s (2012) article, Bonnie positioned herself as the “dumb” student as a result of her interactions with her group member, Teri. In my study, Jasmine also described herself based on her interactions with others, such as when she stated that she was better at mathematics because of her teacher.

Discrepancy Between Prepositions, Enduring Positions, and/or Positions

One preposition/enduring position Jasmine described that did not appear in my coded observational data was *understanding mathematics*. Jasmine described the position of understanding mathematics as times when she was confident in her mathematical abilities or

when she performed well and got answers correct. The position of understanding mathematics was more difficult to observe without access to Jasmine's mathematical work. Though I did not code any in-the-moment positions as understanding mathematics, there were times Jasmine displayed confidence and mathematical authority. These instances were instead coded as *participating in class*. However, Jasmine confidence in her mathematical knowledge (i.e., the preposition/enduring position of understanding mathematics) was often a prerequisite to her taking on the position of participating in class.

Another preposition/enduring position Jasmine frequently mentioned that was not as prevalent in my observations was *ostracized*. Jasmine's previous experiences of being ostracized from her friends and family members deeply scarred her. Even years later, Jasmine still carried the fear of being rejected because of her learning dis/ability. Though this preposition/enduring position was very influential for Jasmine, there was only one instance that I observed Jasmine actually take on the position of ostracized. Assuming that my observational period was fairly representative of Jasmine's mathematical experiences in her classroom, it was thus rare for her to be positioned as ostracized. The one instance of ostracization occurred when one of Jasmine's group members went to get calculators for the three other girls at her table. The student only came back with two calculators, however, one for herself and one for the girl sitting next to her. This left Jasmine and one other student without a calculator. The reason for this student's act of ostracization is unknown, but it is unlikely that it was motivated by Jasmine's learning dis/ability. Not only was the student unaware of this label, but Jasmine was not the only student in this instance who was ostracized. Though Jasmine did not often experience the position of being ostracized, she took on other positions such as *need for social acceptance*, *lack of*

mathematical participation, and *mathematical inferiority*. These in-the-moment positions represented Jasmine's attempts to avoid being ostracized.

In addition to the disconnect between Jasmine's descriptions and my observations, there were also times Jasmine's described expectations of how an interaction should occur (i.e., prepositions) differed from the enduring positions she repeatedly experienced. Jasmine's in-the-moment positions were at times informed by these disconnected prepositions. For example, Jasmine described the preposition of *overwhelmed* when asked what would happen if she shared an incorrect answer in class. Though Jasmine felt overwhelmed at the prospect of sharing an incorrect answer, in her interviews she mentioned that the students in her class did not really react or care when another classmate got an answer incorrect. The culture in Jasmine's classroom—as created by her teacher and the students—provided a space where it would be safe for Jasmine to make a mathematical mistake without being judged. However, the preposition of overwhelmed still inhibited Jasmine from participating in class. This disconnected preposition was another representation of the anxiety Jasmine had to hide her struggles with mathematics in an effort to remain accepted by her peers.

Frequency of Interactions

Teacher Interactions. The frequency of mathematical interactions between the teacher and Jasmine differed from the frequency of interactions between the teacher and other students in the class. As stated in the results, Jasmine's two mathematical interactions accounted for only 1.27% of the total number of interactions for the entire class. Assuming an even distribution amongst the 26 students in Jasmine's class, each student should have received 3.85% of the interactions. This hypothetical even distribution implies that Jasmine should have participated in six out of the 158 total interactions. Though it was theoretically very unlikely for the number of

interactions to be perfectly distributed amongst the students, this difference was significant. As I described above, Jasmine's lack of mathematical interactions was not purely a result of her teacher: her teacher came to check on Jasmine's group multiple times during each class period and called on Jasmine once to share her work. Instead Jasmine was the one who limited the mathematical interactions by avoiding asking and answering questions. The lack of mathematical interactions was thus a reflection of Jasmine's self-positioning of *lack of mathematical participation*.

The percentage of non-mathematical interactions between Jasmine and her teacher was 5.30%. Though this percentage was higher than the hypothetical even distribution of 3.85%, I did not observe a noticeable difference between how frequently Mrs. Pratt interacted with Jasmine compared to the other students. Most of the non-mathematical teacher interactions between them were verifying instructions, Jasmine asking for permission to go to the bathroom, etc. It was rare for Mrs. Pratt to discipline Jasmine, as she only asked her to put her phone away and pay attention a few times. The non-mathematical interactions instead highlighted the comfortable relationship Jasmine described having with her teacher in her interviews.

Student Interactions. The percentage of Jasmine's mathematical interactions within her small group of four students was much higher than the percentage of interactions with her teacher. Out of the 71 student-to-student mathematical interactions in her group, Jasmine participated in 28 of them, resulting in 39.44%. Additionally, Jasmine participated in 62.69% of the student-to-student non-mathematical interactions. The higher percentage of student interactions can be partly explained by the smaller number of participants in Jasmine's group. As there were fewer students, there was a higher probability of her participating in any given interaction. In addition to the smaller number of participants, Jasmine's descriptions of the

enduring positions of *receiving help from her classmates* and the *need for social acceptance* also explained her participation. Jasmine described that when she felt socially comfortable with her peers, she would be more likely to ask them for mathematical help. Jasmine's non-mathematical interactions with her peers illustrated her social ease with her group members, which then made her more comfortable to engage with them mathematically.

Similar to my study, Bishop (2012) also counted and categorized the types of interactions between her case study students. She concluded that each students' positioning influenced how frequently they engaged in different types of interactions. For example, Teri (the "smart one") used an authoritarian voice 53 times with Bonnie (the "dumb one"), whereas Bonnie only used an authoritarian voice once with Teri. The frequencies of Jasmine's interactions in my study were also representative of the positions she assumed, such as *lack of mathematical participation* in the overall class and *receiving help from other students* within her small group.

Focal Student #2: Taylor

Academic Insecurities

Based on Taylor's prepositions, enduring positions, and in-the-moment positions, much of Taylor's mathematical identity was driven by her academic insecurities. In her interviews, she frequently described herself as *not smart*, categorizing herself this way because of her mathematics learning dis/ability. She described that her learning dis/ability made her "terrible" at mathematics because it took her longer to understand concepts. As a result, she often found it difficult to keep up in her fast-paced class. Though there were not any in-the-moment positions that I coded as not smart, Taylor's academic insecurities still shaped her mathematical identity. For example, though Taylor described the preposition/enduring position of *asking questions*, her academic insecurities inhibited her from taking on this position during class. She refrained from

participating and asking questions specifically because she was scared it would slow her down, causing her to fall even further behind. Additionally, Taylor was not comfortable sharing her mathematical ideas in class because she was scared of getting an answer incorrect. She mentioned that if she did share an incorrect answer, she would be “quite embarrassed.” This fear of appearing not smart in front of her classmates inhibited Taylor from participating in class and instead caused her to take on the positions of *working alone* and *invisible*.

Taylor’s academic insecurities mirrored other researcher’s findings that students with mathematics learning dis/abilities are not confident in their mathematical abilities (Heyd-Metzuyanim, 2013; Lambert, 2015). For example, a student with a mathematics learning dis/ability in another study described herself as “not good” at mathematics (Heyd-Metzuyanim, 2013, p. 360), highlighting an enduring position very similar to Taylor’s.

Different Than Others

Taylor also frequently described characteristics that made her different from her peers, including her learning dis/ability, her physical appearance, and the fact that she was adopted. Along with her academic insecurities, these differences also influenced Taylor’s mathematical identity, or the positions she took on during class. Just as the fear of appearing not smart inhibited Taylor from participating in class, the social differences she described also inhibited her participation, causing her to isolate from her peers. During class she always assumed the position of *working alone*, even when she had the opportunity to work with those around her. Additionally, though at times she socialized with a few students before or after class, she did not think of them as friends. Instead she said, “I mostly consider them as classmates.”

Taylor described how her differences influenced the way others treated her. She mentioned that her teachers were easier on her because of her accommodations and that her

friends spoke to her in a baby voice. However, Taylor did not believe that these people were aware that they treated her differently. In fact, Taylor frequently described a disconnect between how she viewed herself compared to how others viewed her. For example, when explaining how her teachers treated her, she said, “To me, I feel like they're kind of easy on me. But to them... probably they just think that they treat everybody the same.” Taylor also described this same disconnect when asked if she thought her friends treated her differently as a result of her learning dis/ability: “Again to me, probably yes. But to them, probably not.”

Taylor’s ability to describe this disconnect between her teacher and friends’ conscious and subconscious behavior shows a mature emotional awareness for a ninth-grade student. However, Lambert (2015) showed that even younger students with mathematics learning dis/abilities pick up on unstated differences in how teachers interact with different students. For example, one middle school case study student commented: “The groups were like smarter than others [although the] teachers don’t say that. [...] [My group] is the unsmartest group” (Lambert, 2015, p. 14).

Though Taylor assumed her teacher and friends were unaware that they treated her differently, their behavior still influenced her mathematical identity. Their treatment—in addition to the physical and academic differences she described—caused Taylor to feel like an outsider. To escape the effects of feeling *different than others*, Taylor took on the in-the-moment positions of *working alone* and *invisible*. For example, she did not like to draw attention to herself during class by asking questions and limited her interactions with her classmates, only occasionally speaking with them before or after class.

Discrepancy Between Prepositions, Enduring Positions, and/or Positions

One enduring position Taylor described in the interviews that did not appear in my coded observational data was *unsure*. Taylor demonstrated this enduring position when she asked questions such as, “What does it mean to have a learning disability?” or “What can I do to get help with my learning disability?” When Taylor asked these questions in the interviews, it was clear that she was unfamiliar with the causes and effects of her learning dis/ability. She mentioned that she did not attend her IEP meetings, which could be one of the reasons for her lack of familiarity. However, by asking these questions in the interviews, she showed her desire to better understand her situation. Though Taylor demonstrated uncertainty in her interviews, she never took on this position during class. She might have been nervous to appear *not smart* or *different than others*: as described above, Taylor did not like to draw attention to herself. Thus, it is possible that there were instances she felt unsure during class but instead ignored her uncertainty and took on the position of *invisible*.

Another enduring position Taylor described that I did not observe during class was *successful at mathematics*. One possible reason I did not code any observational interactions with this position is because I did not have access to Taylor’s written work. As Taylor never participated in class discussions, there was no other way for me to know if her mathematical thinking was correct or not. Thus, the absence of this coded in-the-moment position does not imply that Taylor was never successful at mathematics during the observational period.

Frequency of Interactions

Teacher Interactions. The frequency of mathematical interactions between the teacher and Taylor differed significantly from the frequency of interactions between the teacher and other students in the class. Though there were 168 total mathematical interactions between the

teacher and any given individual student, only two of those were with Taylor. As a result, Taylor's two mathematical interactions only represented 1.19% of the total mathematical interactions for the entire class. Assuming an even distribution amongst the 30 students in Taylor's class, each student should have received 3.33% of the interactions. This calculation implies that each student should have theoretically participated in five to six interactions which is almost three times as many interactions as Taylor participated in. As I stated before, I recognize that it was unlikely for this perfect distribution to occur. However, Taylor's lack of mathematical interactions was still remarkable.

Taylor's low frequency of mathematical interactions with her teacher was important because it was a result of her mathematical identity. Taylor's mathematical identity—meaning the in-the-moment positions she took on—limited her interactions with her teacher in class. For example, when Taylor assumed the position of *invisible*, she did not raise her hand to ask questions or participate in whole-class discussions. As a significant portion of the mathematical interactions happened while the teacher called on individual students during class discussions, Taylor's self-positioning as invisible limited her opportunities for mathematical interaction. Additionally, Taylor's teacher did not make any observable effort to engage Taylor in these discussions. When I asked Taylor to explain this and describe if the teacher called on certain students more than others, Taylor said: "Mostly they're raising their hands more than the teachers are calling out to people." So based on Taylor's description, the opportunity to participate in mathematical interactions was more student-directed than teacher-directed.

In addition to the low frequency of mathematical interactions, it was also rare for Taylor to receive high-quality mathematical feedback. For example, there were times when the teacher was walking around the room and quickly glanced at Taylor's work without commenting.

Furthermore, both instances that Taylor interacted mathematically with Mrs. Jones, her teacher, she received *direct instruction*. Though Mrs. Jones once asked Taylor a mathematical question, she did not wait for her to answer before telling her how to proceed. This implies that Taylor's mathematical ideas were not valued by her teacher in the two interactions I observed.

Though Taylor did not frequently engage with her teacher mathematically, she did engage with her non-mathematically. Taylor's non-mathematical interactions with Mrs. Jones accounted for 6.42% of the class total. Many of these interactions occurred before class started. Taylor would spend her time before school in her mathematics classroom, highlighting the comfortable relationship she had with her teacher. However, once class started, Taylor limited her interactions with Mrs. Jones, only occasionally verifying instructions or clarifying where she should turn in her assignments.

Student Interactions. I did not count the number of interactions between individual students for the class overall as Taylor's teacher did not explicitly encourage students to work together. Additionally, as the desks were arranged in rows, the set-up of the classroom was not very conducive to group work. Though I did not count the total number of interactions between individual students, I still counted the interactions Taylor participated in. Over the course of five class periods, she participated in four non-mathematical interactions with another student. The absence of student mathematical interactions and the small number of non-mathematical interactions further highlighted the positions of *invisible* and *working alone* that Jasmine took on each and every day.

Comparing and Contrasting Jasmine and Taylor

Even though Jasmine and Taylor were individuals who described unique prepositions and enduring positions, there were still similarities between their mathematical experiences. For

example, both students had limited mathematical interactions with their teachers: both Jasmine and Taylor only had two mathematical interactions with their respective teacher over the course of five class periods. Though Jasmine and Taylor were similar in this way, the reason behind these limited interactions was unique for each student. Jasmine limited her mathematical interactions with her teacher because she was *overwhelmed* by the possibility of getting an answer wrong in front of her peers. Even though Jasmine's teacher attempted to interact with Jasmine mathematically by frequently checking in on her group, Jasmine still did not answer or ask any questions in order to maintain *social acceptance*. Unlike Jasmine, Taylor did not limit interactions with her teacher because she was concerned with being socially accepted by her peers. She avoided mathematical interactions because she did not like feeling pressured or being the center of attention. In addition to preferring to maintain *invisibility* during class, Taylor's avoidance of mathematical interactions was also motivated by the fear that asking questions would slow her down, causing her to fall behind in the material.

Though Jasmine and Taylor were similar in some ways, they were also very different. One of the biggest differences between Jasmine and Taylor was how their mathematics learning dis/ability affected their mathematical identities. First, Jasmine's mathematics learning dis/ability caused her to take on positions that demonstrated an intense need for social acceptance. For example, when she discussed how her learning dis/ability affected her, she always described how it shaped her relationships with her teacher, family, and friends. In class, Jasmine also frequently engaged in casual conversations with her group members in an attempt to maintain *social acceptance*. She worked hard to maintain this social acceptance because one of her biggest fears was being *ostracized* by her classmates if they found out she had a learning dis/ability. Unlike Jasmine, Taylor was not motivated by a need for social acceptance. She was not concerned with

forming and maintaining friendships with her peers, saying that she viewed them as “mostly as classmates.” Though she described some social differences she felt, such as the fact she was of Asian descent and adopted, Taylor more frequently described her failure to understand mathematics. As a result, Taylor’s learning dis/ability caused her to take on positions that demonstrated academic anxiety rather than social anxiety.

It is possible that the contrast between Jasmine’s social anxiety and Taylor’s academic anxiety was solely due to differences in their past experiences and personalities. For example, Jasmine’s rejection by her friends in elementary school likely influenced her later *need for social acceptance*. If Taylor had experienced a similar rejection, perhaps she might yearn for social acceptance the same way Jasmine did. In addition to the differences between the girls’ experiences and personalities, another possible reason for this contrast could be the setup of their mathematics classrooms. Jasmine’s classroom was very student-centered and included a lot of group work and participation. As a result, the expectation that students should interact mathematically with their peers every day could have further contributed to Jasmine’s need for social acceptance. Contrastingly, Taylor’s classroom was very teacher-centered. So perhaps her lack of interest in being socially accepted by her peers was a result of a classroom that did not value group work. If Jasmine and Taylor were instead in similar classrooms, would their mathematical identities still be different? I discuss this and other ideas for future research in the next chapter.

Connecting Jasmine and Taylor’s Positions to their Dis/abilities

Both Jasmine and Taylor assumed a variety of in-the-moment positions during their respective mathematics classes. For example, Jasmine took on positions such as *need for social acceptance* and *lack of mathematical participation*; Taylor took on positions like *invisible* and

working alone. However, solely studying these isolated in-the-moment positions was not enough to assume that they were influenced by the students' mathematics learning dis/abilities. For example, it could be that Jasmine took on the position of *lack of mathematical participation* because she was shy, tired, etc. In order to address these other possible causes, I relied on the data from the interview process. Both the pre- and post-interviews focused specifically on the students' experiences with their mathematics learning dis/abilities: I asked questions such as, "How do you feel about being labeled as mathematics learning dis/abled?" and "How does your label as mathematics learning dis/abled affect your participation in class?" By listening to the voices of my focal students as they answered these questions, I was able to better understand how Jasmine and Taylor's dis/abilities shaped their mathematical experiences. As I have outlined throughout my discussion, the prepositions and enduring positions that Jasmine and Taylor described in their interviews informed the in-the-moment positions they assumed during class. Since these prepositions and enduring positions were generated by their perceptions of their learning dis/abilities, I confidently conclude that the positions I observed them take on were influenced at least in part by those same dis/abilities.

For example, Jasmine assumed the position of *need for social acceptance* because of a specific experience in her past where she was rejected because of her learning dis/ability. Though this experience occurred during elementary school, it still impacted Jasmine's behavior years later. In her post-interview, she described that she was still nervous that her friends would reject her if they found out about her dis/ability. Thus, her interview data showed her intense desire to maintain acceptance from her peers was directly connected to her dis/ability. Another position that Jasmine took on during class was *lack of mathematical participation*. Jasmine's interview data also showed that this position was tied to her mathematics learning dis/ability. In

her post-interview, Jasmine described that she did not like to participate in class because it made her nervous. This nervousness once again came from Jasmine's fear of being judged and rejected by her friends for having a learning dis/ability. I also shared the connections I have described with Jasmine during her post-interview. She confirmed that she agreed with these connections.

Just as Jasmine's dis/ability influenced her in-the-moment positions, Taylor's dis/ability influenced her positions as well. For example, Taylor preferred to assume the positions of *invisible* and *working alone*. Without her interview data where she stated that she believed her learning dis/ability made her different than her peers, it would be impossible to truly know the reason for Taylor's isolating in-the-moment behaviors. However, her descriptions of feeling slower than her peers because of her dis/ability, in addition to her belief that her peers treated her differently because of her dis/ability, explained her motivation for separating herself from her classmates. Taylor confirmed these reasons during her post-interview when I shared my initial conclusions with her. Thus, the claims I am making about how Taylor's dis/ability affected her positions also resonated with Taylor herself.

As demonstrated by these examples from the data, attending to Jasmine and Taylor's personal descriptions of their experiences with their learning dis/abilities (i.e., their prepositions and enduring positions) allowed me as a researcher to better interpret the positions I observed them take on during class. My interpretations—which connected the students' behaviors to their dis/abilities—were only possible because of the stories the students shared. Their descriptions helped me as a researcher to better understand their realities of navigating the educational system with a mathematics learning dis/ability.

CHAPTER 5: CONCLUSION

Until very recently, students with mathematics learning dis/abilities have been an invisible population in the field of mathematics education (Karp, 2013). Instead, most of the research on the mathematics teaching and learning for students with mathematics learning dis/abilities has been done in the fields of psychology and special education (Karp, 2013; Lambert, 2015; Lambert & Tan, 2016; Lambert & Tan, 2017; Tan & Kastberg, 2017). This disparity is problematic because the divide between the fields of mathematics education and special education treats students with and without dis/abilities very differently. For example, instead of receiving access to reform-based mathematics instruction, students with dis/abilities are more likely to receive direct instruction that is focused on rote memorization (Jackson & Neel, 2006). Within the research community, students with dis/abilities are additionally characterized by their deficits and difficulties and are often believed to be incapable of being successful in school mathematics (Anderson, 2009; Lambert, 2015).

These deficit beliefs about students with mathematics learning dis/abilities color the interactions these students have with their schools, teachers, and peers (Bishop, 2012; Heyd-Metzuyanim, 2013; Lewis & Lynn, 2018). These interactions are important because they directly shape these students' mathematical identities (Davies & Harré, 2001; Harré, Moghaddam, Cairnie, Rothbart, & Sabat, 2009). In order to better understand how students with mathematics learning dis/abilities form their mathematical identities (i.e., the in-the-moment positions they are assigned or take on), my study used an extended version of positioning theory (Harré, 2012). In addition to studying these students' in-the-moment positions, I also studied their prepositions and enduring positions (Anderson, 2009; Harré, Moghaddam, Cairnie, Rothbart, & Sabat, 2009;

Johnson, 2016). Using this extended theoretical lens, my study answered the following three questions:

1. What prepositions and enduring positions do students with mathematics learning dis/abilities describe in their experiences with mathematics learning?
2. What positions are observed by a researcher in the current mathematics classes for the same students with mathematics learning dis/abilities?
3. How do these positions compare with one another?

My results showed that the mathematical identities of my two focal students were influenced by the prepositions and enduring positions they described. Therefore, understanding the expectations they had before engaging in an interaction (i.e., prepositions) and their descriptions of their repeated previous experiences (i.e., enduring positions) helped me to better understand the in-the-moment positions they took on during class (i.e., their mathematical identities).

In this chapter, I outline the contributions my study makes to the field of mathematics education. I then outline implications for both researchers and practitioners. Lastly, I identify the limitations to my study and give suggestions for future research that will address these limitations and deepen researchers' understanding of students with mathematics learning dis/abilities.

Contributions

My study makes several contributions to the field of mathematics education. First and foremost, it is one of few studies in the field that explicitly attends to students with mathematics learning dis/abilities. As I described in Chapters 1 and 2, research regarding students with dis/abilities is most often performed in the fields of psychology and special education. However,

the research in these fields is overwhelmingly deficit-oriented and very likely to be analyzed using a behaviorist or cognitive learning theory (Lambert & Tan, 2016; Lambert & Tan, 2017). Contrasting this pattern of studies involving students with mathematics learning dis/abilities, my study is not deficit-oriented. Though other mathematics education researchers have also pushed for research that positively portrays students with dis/abilities (Lambert, 2015; Lambert, Tan, Hunt, & Candela, 2018; Lewis, 2014; Lewis & Fisher, 2016; Lewis & Lynn, 2018; Yeh, Ellis, & Mahmood, 2020), much of the work that has been done is either founded on constructivist learning theories or is a review of the existing literature. My study contributes to this body of research by adopting a sociocultural lens, focusing on the social and affective factors related to the learning and doing of mathematics for these students. Diversifying the theoretical perspectives used to understand the teaching and learning of students with mathematics learning dis/abilities is necessary for providing more equitable learning opportunities. Using the sociocultural theoretical framework of positioning theory, I was able to specifically attend to the mathematical identities of students with mathematics learning dis/abilities. In order to do this, I relied on the past and current experiences of my focal students. Therefore, my study is also an important example of giving voice to students with mathematics learning dis/abilities so that we as researchers and practitioners can better understand their mathematical identities. My study, then, adds to the research on counternarratives from marginalized populations experiences in learning mathematics (Berry, Thunder, & McClain, 2011; Gutiérrez, Willey, & Khisty, 2011).

My research also makes a theoretical contribution to the field of mathematics education. I studied identity in a new way by using an extended version of positioning theory. While traditional positioning theory attends solely to in-the-moment positions, I also attended to students' prepositions and enduring positions in my study. Contrastingly, other identity studies

that have used positioning theory in mathematics education have only attended to one of these aspects. For example, Bishop (2012) solely attended to in-the-moment positions and Anderson (2009) explored students' enduring positions. But by using a theoretical framework that allowed me to attend to prepositions, enduring positions, and in-the-moment positions simultaneously, I was able to better understand how these three components worked together.

Lastly, in addition to the theoretical contribution my study makes, the results of my study also give important insight into the mathematical identities of students with mathematics learning dis/abilities. While Lambert (2015) studied the effects of different pedagogies on the mathematical identities of students with dis/abilities, my study examined how their identities were shaped by their personal prepositions and enduring positions. As I have discussed, my results showed that my students' prepositions, enduring positions, and in-the-moment positions were closely connected. By attending to all three of these very personal aspects, my study helps researchers and teachers better understand *why* students with mathematics learning dis/abilities take on certain in-the-moment positions. Both my focal students' prepositions and enduring positions were very influential in determining their in-the-moment positions. For example, Jasmine's enduring position of *ostracized* contributed to her repeatedly taking on the position of *need for social acceptance* during class. As my study has shown, in order to truly understand the mathematical identities (i.e., in-the-moment positions) of students with mathematics learning dis/abilities, researchers must attend to their prepositions and enduring positions as well.

Implications

Implications for Research

Along with the other mathematics education researchers who have called for more research on students with dis/abilities (Lambert, Tan, Hunt, & Candela, 2018; Lewis & Fisher,

2016; Lewis & Lynn, 2018; Yeh, Ellis, & Mahmood, 2020), my study also implies that non-deficit-oriented research is the key to truly understanding students with mathematics learning dis/abilities. My study shows that giving voice to these students' and their experiences—instead of categorizing and labeling their academic difficulties—is a crucial step in understanding how they form their mathematical identities. Attending to the social and affective experiences of these students is just as important as understanding their cognitive processes. As a result, researchers should continue to use sociocultural and sociopolitical learning theories to study the teaching and learning of students with mathematics learning dis/abilities.

Additionally, as my study's new way of using positioning theory allowed me to more deeply understand my focal students' mathematical identities, mathematics education researchers should continue to attend to more than just the in-the-moment positions when studying identity. Identity is complex, and my results showed that it was also influenced by prepositions and enduring positions. By continuing to research how prepositions, enduring positions, and positions relate together, researchers will be able to make further conclusions about the mathematical identities of students with mathematics learning dis/abilities.

Implications for Practice

My study also informs the work of teachers and other practitioners in schools. First, my results showed that teachers directly influence their students' mathematical identities. Jasmine, for example, frequently mentioned how influential her teacher was in helping her feel confident and comfortable with mathematics. In order to positively influence the mathematical identities of their students with mathematics learning dis/abilities, teachers should create a classroom climate that provides both mathematical and social support. As teachers create safe environments for

their students with mathematics learning dis/abilities, the students can feel comfortable asking questions and sharing their mathematical ideas.

In addition to creating a safe classroom environment for their students with mathematics learning dis/abilities, teachers should also be conscious of the interactions they are having with these students. First and foremost, they should ensure that they are actually having mathematical interactions with these students, as both Jasmine and Taylor had very few mathematical interactions with their teachers. In addition to making sure these mathematical interactions are actually happening, teachers should make efforts to make these interactions high-quality. For example, they should ask questions and then listen to the ideas of their students with mathematics learning dis/abilities. Increasing the number and quality of mathematical interactions with these students can help positively influence their mathematical identities.

Limitations and Directions for Future Research

One limitation to my study is the possibility that the positions I observed were not unique to my focal students with mathematics learning dis/abilities. For example, one of the positions Taylor was given was *lack of mathematical feedback*. However, it is possible that other students in Taylor's class also experienced this position, implying that it was not a direct result of Taylor's label as learning dis/abled. Though as a single researcher I was unable to record and compare the teacher's mathematical interactions with students other than my focal student, this data would give more context to the positions my focal students took on.

Another possible limitation to my study also arises from my lack of data on the other students in Jasmine and Taylor's classes. My results showed that Jasmine and Taylor participated in a very limited number of mathematical interactions with their respective teachers. However, because I was unable to count and categorize the interactions for every other individual student, I

do not fully understand the implications of my focal students' limited interactions. For example, it is possible that there were many other students who did not extensively interact with the teacher. A comparative study between the frequency of interactions between students with and without a mathematics learning dis/ability would provide data to make a more informed conclusion on this topic.

Another limitation to my study is that my focal students' responses could have been influenced by my interview questions. For example, I noticed that my focal students did not describe prepositions as often as they described enduring positions. This difference could be because the majority of the questions asked them to describe their past experiences (i.e., enduring positions). To counteract this, future studies could include more hypothetical questions that push students to describe their expectations for how an interaction should occur (i.e., prepositions). However, an additional possibility for the lower number of prepositions could be that my focal students already had stable conceptualizations of their mathematics experiences after their nine years of schooling. So instead of focusing on hypotheticals in the interviews, they instead described what they had consistently and repeatedly experienced.

With only two focal students, my study just began to explore the mathematical identities of students with mathematics learning dis/abilities. Additional research on this topic with other qualified students must be done in order to better understand their experiences. Additionally, my study only attended to these students' prepositions, enduring positions, and in-the-moment positions. Another possible direction for future research would be to extend to broader levels of positioning theory and attend to storylines (Harré, 2012). Studying the storylines students with mathematics learning dis/abilities use to guide their positioning will help researchers further understand their mathematical identities. This analysis could also be accomplished by using the

theoretical framework of figured worlds (Holland, 2001; Urrieta Jr., 2007). Attending to these larger components of identity would help researchers address how classroom setup influences identity development. For example, would Jasmine and Taylor's identities be stable even if they were in different classrooms? Answers to questions such as these will help further situate their prepositions, enduring positions, and in-the-moment positions.

Finally, researchers could conduct identity studies for students with mathematics learning dis/abilities throughout different stages of their development. For example, it would be interesting to see the prepositions, enduring positions, and in-the-moment positions young students with mathematics learning dis/abilities take on. Replicating this study with younger students would give researchers information on their identities before they become relatively stable and solidified. Additionally, tracking how students' identities change and progress over time would give additional context, especially to the enduring positions they describe.

Conclusion

This study examined the mathematical identities of students with mathematics learning dis/abilities, a group that comprises approximately 7% of the school-aged population (Geary, 2011). In order to understand these students' mathematical identities, I attended to their prepositions, enduring positions, and in-the-moment positions. Though my two focal students had unique perspectives and experiences, their results both showed that the positions they assumed during their mathematics classes were dependent on the prepositions and enduring positions they described. Consequently, researchers must continue to simultaneously attend to the prepositions, enduring positions, and in-the-moment of students with mathematics learning dis/abilities. Doing so will help researchers and teachers better understand these students'

mathematical identities, allowing them to provide more quality and equitable experiences for their students with mathematics learning dis/abilities.

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APPENDIX A: PRE-INTERVIEW PROTOCOL

1. How do you feel math has been going for you this year?
2. Say a new student moved into your school and he or she wanted to know what a person had to do to be successful in your math class. What would you say?
3. Say that your school needed to hire a new seventh-grade math teacher and you were asked for advice on what would make a good seventh-grade math teacher. What would you say?
4. Are you more likely to participate during class or listen? Why?
 - a. What if you contributed an answer during class discussion and it was incorrect? What would your reaction be?
5. Who is the smartest person in class? How do you know they are the smart person?
 - a. Is the smartest person in class part of a group of smart people? Are there other kinds of people? Like popular kids? How do you know?
6. Who is the least smart person in class? How do you know they are the least smart person?
7. Does the teacher interact with kids differently? In what ways?
 - a. Do you work in groups or alone? How does your teacher pick the groups?
8. How do you feel about being labeled as mathematics learning dis/abled?
9. How does your label as mathematics learning dis/abled affect your participation in class? Do you think you participate more or less than your other classes?
10. How does your label as mathematics learning dis/abled affect how your teacher views you?
 - a. Do your teachers in other classes view you differently than your math teacher?
11. Do your friends know you have mathematics learning dis/ability?
 - a. If they don't know, why?
12. How does your label as mathematics learning dis/abled affect how your friends view you? Do they treat you different in math class versus outside of math class?
13. Are you better or worse at math because you have a mathematics learning dis/ability?
14. Is there anything else you want to tell me about your math class or how you feel about math?

APPENDIX B: POST-INTERVIEW PROTOCOL

1. When I was observing, I noticed ____ happened when you interacted with <teacher or student>. [possible insert other explanation of the moment if needed for clarity] Do you remember that moment? [provide additional details of moment if needed until the moment is mutually agreed upon or the student cannot remember the moment]
 - a. Why did you _____ [description of the thing they did such as rolling their eyes or providing an answer to the question]?
 - b. Is that how you would normally interact in this kind of situation?
 - c. Would you have acted any differently in another class?
 - d. How did this moment make you feel?
2. [question 1 will be repeated for the various moments identified by the researcher]
3. Are there any moments that we didn't talk about that you think were important?
 - a. Why were those moments important?
4. [using each of their identified moments similar to post-interview question 1]
 - a. Why did you _____ [description of the thing they did such as rolling their eyes or providing an answer to the question]?
 - b. Is that how you would normally interact in this kind of situation?
 - c. Would you have acted any differently in another class?
 - d. How did this moment make you feel?
5. Part of my study is to come up with a way of describing who you are in math class by telling people about how you participate and feel about participating and how you are learning in math class. So I have a couple of examples of things I think about you and I want to see how you feel about these descriptions. [describe early results of pre-positions and enduring positions (one at a time and ask the following questions about each)]:
 - a. What do you think about [this pre-position or enduring position]?
 - b. How am I wrong in describing you?
 - c. What did I get right about describing you?
 - d. How does this description make you feel?
 - i. Why do you think you feel that way?